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ELECTRICAL GROWTH IN 1907-8.

The past year was one of extraordinary conditions, with unparalleled prosperity at one end, unsurpassed depression at the other, and a sharp return to normal average conditions as it closed and became history. On the surface, business was brisker than ever throughout the first half of the year, but it was increasingly difficult to finance industry, and the high price of materials and labor drove many consumers into a policy of retrenchment that came none too soon to mitigate the strain of the last three months. It is difficult to tell how far purchases and consumption fell off after June, but it is well known that in many quarters the process of restriction began then, and has prevailed up to the present moment. Hence, one of the best and brightest aspects of the situation is the very general absence of overproduction. We know of no instance in the electrical field where goods have been forced on the market because of glut or in an endeavor to realize; and this appears to be equally true of practically every other field of manufacture. On the contrary, there are instances where a return to average, standard prices, as in the case of copper, has been followed by an immediate stimulation of demand. Some day copper, when scarcer, may be actually worth 25 cents a pound, but no man in his senses wanted to buy it at that figure last year unless he had to have it, cost what it might. In like manner, labor had reached a point of costliness and inefficiency that was positively appalling to anybody trying to earn a return on his business by prudent management.

All this has necessarily complicated and confused any attempt at review and survey, but the effort may be made along lines that are familiar to our readers. The following table is offered as an approximation to the electrical sales and earnings of 1907, as compared with 1906:

	1906.	1907.
Electrical apparatus	$250,000,000	$275,000,000
Street railways	360,000,000	385,000,000
Electric lighting	175,000,000	225,000,000
Telephony	165,000,000	200,000,000
Telegraphy and cable	50,000,000	55,000,000
Isolated plant supply	100,000,000	110,000,000
Miscellaneous	40,000,000	50,000,000
	$1,140,000,000	$1,300,000,000

With regard to some of these figures there is no element of doubt, because the statistical bases are well established and the percentages of growth are well known. Thus, land telegraphy is stagnant, but submarine cables do a larger business every year. Telephony has been expanding at a rate of 40 or 50 per cent annual increase, but it got a check last year. Street railway increase has settled down to a 7 to 10 per cent gain, depending apparently on the growth of population and the extension of facilities as the dominant factors, but checked by all kinds of assault on the 5-cent flat fare. It is probable that the real earnings per passenger to-day do not exceed 3 cents, if they reach it. Central station earnings, on the other hand, have gone forward tremendously, partly as a result of the greater

availability of circuits and electricity, and partly because of the energetic business-getting campaigns of the last three years. A rate of increase of 30 per cent has been reached in a great many instances, but would not apply all over the country.

Our readers are themselves "sitting in the game," to use a colloquialism, and can check up our statistics and estimates as to the past. What 1908 has in store no one knows. But judging the future by the past, believing in the steady evolution of the arts, realizing the larger place that electricity plays all the time in human affairs, we predict that 1908 will see new standards attained and new high-water marks. Reducing faith and hope and evidence of growth to values, we place total electrical earnings in 1908 at $1,500,000,000.

The Arrival of the Tungsten Lamp.

The beginning of the year 1908 will probably mark the coming of the American-made tungsten lamp on the American market. Foreign-made tungsten lamps have been regularly on the market for the past nine months, but in quantities too limited to supply the general demand. American makers now claim to be turning out tungsten lamps in quantities which make them available for every-day use. Methods of manufacture and shipment have been improved so that breakage of filaments in shipment is not the serious obstacle it was some months ago. American manufacturers have adopted for the present three standard sizes, consuming 100, 60 and 40 watts, and giving, respectively, 80, 48 and 32 mean horizontal candle-power; or, in other words, taking 1.25 watts per mean horizontal candle.

So far, the tendency of manufacturers has been to put out these lamps with clear glass bulbs. This is a rather illogical proceeding in view of the common practice of sending out carbon-filament lamps of similar candle-power with frosted tip bulbs. To be sure, one can order whatever he wishes, but the majority of users take what the manufacturer supplies regularly. It is certain that the tungsten lamp of 32 candle-power and over is entirely too powerful an illuminant to be placed around promiscuously without diffusing glass between it and the eye. By frosting the tips of these lamps and putting them in bowl-shaped reflectors which cover all but the tip of the lamp, they are made more bearable, but are still decidedly too powerful for eye comfort when placed in small rooms at ordinary chandelier heights. After all, perhaps the practice of the manufacturers in sending out these lamps with clear bulbs may not be without benefit, because thereby users will be impressed with the importance of putting lamps high up out of range of vision and placing them behind diffusing ceiling hemispheres or in large diffusing globes which will reduce the glare. The tungsten lamp being three times as efficient as the carbon-filament lamps in common use, it is not necessary, for the sake of economy, to place lamps as low as formerly or to have them so near the work. It is also possible to light a small room sufficiently for reading or close work with no greater amount of current than before without going to the trouble and inconvenience of providing small lamps in different parts of the room. It is not, however, to be expected that the tungsten lamp will be "easily domesticated" as long as it is made in such high candle-powers. In residences there are many places where lamps of 8 candle-power or 4 candle-power are entirely adequate, and it is only in some of the more important rooms of the house that higher candle-power lamps can be used to the best advantage.

In the illumination of larger interiors like stores and offices, the candle-powers in which tungsten lamps are being made are well suited. It is safe to predict that there will be some reduction in the maximum demand of stores due to the use of tungsten lamps, although the ultimate effect will be that more light will be used and the electrical energy consumed per year will, on the whole, be greater. The shrewd central-station manager will attempt to draw advantage from the incentive which the increased economy of the tungsten lamp will have toward causing customers to use artificial lighting more hours per day, with perhaps a reduced maximum demand. For example, a merchant who has been closing up his store and turning off all lamps at 6 o'clock may be induced to keep his window lighting turned on during the evening or even the whole interior of his store as an advertisement. He may not be paying the central station much more in dollars and cents, but his maximum demand has been reduced and his hours of consumption increased. The station and distribution system capacity thus set free can be sold to other customers and the revenue per dollar invested in a central station enterprise can be increased. This is what the advent of the tungsten lamp will mean to the live central-station manager. To the one who is not alive to his opportunities, it will simply mean that the rate of increase of his load will be slowed down for a few years without any change in the earning capacity of the plant per dollar invested.

Electric Energy Transmissions.

The year past has been like several previous ones, unproductive of sensational work, but, nevertheless, full of substantial activity. Of new plants there have been many described in our columns. The scene of the greatest activity has perhaps been in the Piedmont region, in the southern Appalachian district, and the Great Falls plant, which we recently described, is, with its 40,000 horse-power, the most considerable of recent hydro-electric installations. There has been a noteworthy extension of the distribution system dependent upon the Niagara group of plants, and that great power is now beginning to assume something of the general industrial importance that is its due. Its development has been along conservative lines, albeit on a very large scale, and its far-reaching circuits are becoming a very important factor in the growth of enterprise in northern New York. The distances covered have not even now become so great as to demand phenomenal voltage, and the voltage record, now a little above 70,000 volts, belongs to the enterprising Michigan plant that has gradually been pushing its pressure into a region hitherto untouched. The success of this year's work at 70,000 volts makes it certain that higher figures will be tried ere long with good operative results. It is, after all, a mere question of insulators, since there is no doubt that transformers can be made thoroughly reliable for voltage considerably above anything yet attempted in commercial practice.

Perhaps the solution of the high-voltage problem will be found in the new suspension insulators, which have this year been put into tentative use and are soon to be applied on a con-

siderable scale. The ordinary forms of insulator, while excellent for voltages now in use, become, when of adequate dimensions for the higher pressures, decidedly troublesome to support, owing to their necessarily considerable height over the cross-arm. Even on the steel towers often used to support high-voltage lines, the requisite strength is not always easy to secure. The suspension insulator supports the wire flexibly, it is very easy to give the striking distance needed for safety even at very high voltage, and a comparatively small number of anchor points gives the requisite strength against longitudinal stresses. Whether the insulators will stand up well against the grinding due to motion of the wires is another matter. Only protracted experience can answer this question, like many another regarding the performance of insulators. The suspension insulators take up a large amount of vertical space on the pole or tower, so much, indeed, as to be almost impracticable save with tower construction. The majority of high-voltage lines of recent building are on towers with spans of 500 ft. or so. The plan has generally worked well, but some weaknesses have been disclosed. Lines with two complete circuits per tower are now looked on askance by cautious engineers, for it has quite usually happened that a failure of one circuit from lightning or other violent cause has at once involved the other. Whether suspension insulators will improve matters in this respect remains to be seen.

Protection against lightning seems to be improving. Grounded steel cable stretched over the circuits has, on the whole, given a pretty good account of itself the past season. It is by no means a panacea, but it often proves a valuable palliative. The electrolytic lightning arrester also, while not in use to a sufficient extent to give ground for a final judgment, has given promise of great usefulness. For the line, the very high price of copper during most of the year has been a tribulation, and has given a strong impetus to the already growing use of aluminum. The weak point of this metal, as is well known, is its low elastic limit, and to meet this difficulty a steel-cored aluminum wire is now being produced, the latter metal forming a complete continuous sheath. It offers a remarkable combination of lightness and strength, but has not yet been used enough to disclose any latent difficulties. In general methods of transmission there has been no change. The character of apparatus and the prevailing frequency remain unaffected by any present tendencies. There is, however, an increasing disposition to adopt European practice and to use three-phase transformers instead of groups, and to use them in units of very large capacity—a striking proof of the confidence inspired by the present methods of transformer construction. Abroad there is still much talk of constant-current transmission, inspired by the undoubted success of the recent Thury plants. While individual generators of this system remain as at present of a maximum output seldom reaching 500 kilowatts, the multiplicity of units will continue to repel most engineers, although this complication is in no small measure compensated by the extreme simplicity of the switching apparatus, which in American practice has become very burdensome. No projects on foot in this country yet involve distances so great as to make the use of constant current a really live issue. Nor has the use of alternating current in railway motors yet progressed far enough to raise seriously the question of a lowered frequency in general transmission practice.

THE YEAR IN ELECTRIC RAILROADING.

Nineteen hundred and seven has been a year of very satisfactory progress in electric traction. While the amount of new work has not been extraordinary, much of it has been of a character bearing more and more closely upon the general use of electricity for transportation. This problem has been approached in this country by a steady growth upward from ordinary interurban work rather than by any startling leap. In our leading issue for 1907 mention was made of the single-phase equipments which were then being installed for the Erie Railroad and for the New York, New Haven & Hartford Railroad. During the past year these two equipments were placed in service, the former in January, and the latter in August. In each case the designers' estimates have proved correct, and success has attended the operation of both motor-cars and locomotives receiving energy directly at 11,000 volts. Those who have examined these equipments closely seem favorably impressed, and the feeling is that such troubles as have been encountered have been subsidiary and incidental rather than vital. Material trouble, now for the most part overcome, has been reported from inductive action on the telephone and telegraph wires, and the necessary conditions of safety and good insulation of the high-voltage conductors have proved difficult to secure. These should, however, be regarded as of a temporary nature. The New Haven system is undoubtedly handicapped by the necessity for a double service with both alternating and direct currents, which causes needless complications, so far as the general system is concerned. It is rather discouraging to the friends of single-phase traction to find steam locomotives still doing the work after months of exasperating delays, yet the general sentiment seems to be that the system will pull through all right in due season.

Considerable development has taken place during the year in the line of commutating-pole, direct-current railway motors for operation at high voltage. In most of the cases in America each motor has been designed for 600 volts, and two have been connected in series at 1200 volts, although the 1200-volt motor has been produced and used successfully. In one case, that of the Albuquerque Traction Company in New Mexico, a 1200-volt, three-wire railway system has been in service, standard 600-volt motors being used. Although direct-current railways in this country have not yet employed motors at greatly increased e. m. f., high-voltage motors of the commutating-pole type have been introduced on some of the foreign roads. On an experimental line of the Vienna railroad an e. m. f. of 2 x 1500 has been used, the motors being wound for 750 volts. At a German blast furnace a small railway has been operated at a direct e. m. f. of 2000 volts, while a trolley e. m. f. of 3000 volts with 1500-volt, direct-current, commutating-pole motors has been seriously considered for railways in Switzerland. There can be no doubt whatsoever that armature and field coils can be thoroughly insulated for 1500 volts. Moreover, in large-size commutators, sparking can be eliminated by the use of auxiliary commutating poles, and flashing can be prevented by the use of compensating windings and by completely isolating each brush in its own compartment. It seems probable, therefore, that the near future will witness the rapid introduction of high-voltage, direct-current railway motors for interurban service where the rotary converter sub-stations necessary with a 600-volt trolley may be omitted by using a direct

e. m. f. not exceeding 1500 volts. The problem assumes a different aspect, however, when the distance becomes so great that substations must be used, because the extra initial cost and maintenance of the 1500-volt motors and converters may then equal the saving incident to their use.

An installation of more than usual interest to American engineers is the three-phase locomotive equipment that has been selected for the Great Northern Railway, as noted elsewhere in this issue. This installation represents the first substitution of three-phase locomotives for steam locomotives in this country. Certain advantages of simplicity and economy were found for the three-phase equipment as compared with the direct-current or the single-phase, as frequently claimed by the advocates of this type of motor for traction. Moreover, the constant-speed characteristics of the induction motor, which has often been held as one of its greatest disadvantages in railway work, were found in this case to be an element in its favor from the standpoint both of recuperation and of automatic speed limitation. In this connection, it is well to draw attention to the fact that the problem of energy recuperation and electric braking has been solved in a satisfactory manner for both the single-phase and the direct-current equipments. The advantage possessed by the polyphase equipment in this respect relates largely to simplicity, since complicated change-over apparatus must be employed with single-phase and direct-current series motors in order to give them shunt-motor characteristics. The operating features of induction motors are so thoroughly understood by designing engineers that it is absolutely safe to predict for the Great Northern three-phase equipment equally as good agreement of operation with the designers' estimates as was true of the direct-current equipment of the New York Central or of the single-phase equipment of the New Haven. Abroad, the three-phase locomotive has done excellent work, having been adopted for the Simplon tunnel and other important installations, but hitherto has made no progress in this country, due to the not unnatural dislike of a double trolley and apparently a certain studied disinclination on the part of most of the manufacturing companies. The Cascade tunnel plant will furnish an excellent demonstration of the system which may prove fruitful. There is no doubt, however, that the single-phase system on a number of medium-sized roads has been doing excellent work, and the simplicity of the overhead work is a strong commendation. We are far yet from having a high-voltage traction system which shows conspicuous superiority for heavy railway service.

From the theoretical side the heavy railway problem has received considerable attention and some valuable papers have been the result. The weak point of all such discussions is that undue stress has generally been laid upon the mere motive power side of the question, while the most troublesome feature of the problem is the relation of electric traction to operating conditions during the necessarily considerable period during which steam and electric locomotives must work side by side or in close relation. Could one start afresh with electric equipment throughout, the situation would be greatly simplified. Electric railroading has been worked out on the basis of passenger traffic, which is on most steam roads altogether subsidiary in earning capacity to the freight traffic. No large electric road has yet taken up freight haulage on a scale sufficient to solve the problems connected with it. On the ordinary electric lines there has been the usual growth in traffic, and considerable progress has been made, especially in the Middle West, in the establishment of through service on interconnecting lines. Opportunities for this are numerous and too frequently neglected. Rolling stock and general equipment remain on the basis already familiar, the chief noticeable tendency being towards the more extensive use of capacious "semi-convertible" cars. The pay-as-you-enter car is being tried to some extent, but it seems very doubtful whether the public will tolerate it, being in nowise the gainer from its use and subjected to considerable inconvenience. In generating stations new equipment, when with alternating current, has been pretty uniformly with turbo-generators, but the direct-current turbo-generator is still upon the dubious list. On one important interurban line running northward from Milwaukee, a striking innovation, for this country, has appeared in a generating plant operated wholly by gas engines worked from producer gas. Results will be eagerly watched for, and ought to prove very satisfactory. Some admirable economy records have been made with turbo-generators during the year, so that gas engines will be harder pushed than heretofore. The increasing number of gasoline-driven cars for branch line service adds, however, another feature to the competition which is liable to upset some previous calculations.

The Year in Telephony.

The art telephonic has made notable progress during the past year, and 1907 would stand out conspicuously if only for the achievements of De Forest, Poulsen and others in wireless telephony. The recent advices from Europe indicate that Poulsen has attained remarkable results over long distances, while the equipment of the American Navy with De Forest apparatus is matter of recent record. We are now promised further achievements in the same direction, and Poulsen is understood to look with serene hopefulness on Atlantic wireless telephonic transmission of speech. After what Marconi has done, anything really seems possible of this nature; at least no one cares to gainsay such bold prophecy.

Turning to the more accepted order of telephonic things, there is little new to note, outside one important event. There was, indeed, somewhat of a slowing down in the rate of growth during 1907 as compared with the years immediately preceding, when an increase of 50 per cent over the preceding annual figures seemed nothing out of the way. It is by no means to be believed that the point of saturation has nearly been reached in the adoption of the telephone, but on the other hand such a pace was evidently too rapid to be maintained very long. It is probable that a gain of 25 per cent was reached throughout the field, and as estimated elsewhere in these editorial pages, the total income or earnings of the industry are placed at not less than $200,000,000. At $30 earned per station, that would give nearly 7,000,000 stations. The figures are probably somewhere in that vicinity, but will be brought out with exactitude by the United States census to be taken this year of the industry, for the second time.

The important industrial event to which we have referred is the abandonment of the old restrictive policy of the Bell management as to sale of apparatus, and the placing of

telephones at the disposal of everybody. Under the régime of monopoly, as is well known, no one but a licensee could even hire a telephone set from the parent company, and every set was tagged and earmarked with all manner of ownership identification. This had much to do with the old and still continuing bitterness against the "monopoly," which has been pounded with more vindictive, savage rhetoric than even Standard Oil itself. But it is obvious that a great change is effected when Bell telephones are sold freely over the counter, that other conditions must also change, and that a great step forward has been taken toward standardization. We observe that the "independent" bodies announce their intention to oppose the Bell system just as before, but those who have witnessed the wars in the telegraph, lighting and traction fields find it hard to believe that the process of unification has not been most appreciably stimulated in telephony. Such economic simplification is, indeed, one of the most irresistible tendencies of our times.

One other feature of telephonic work on this side of the Atlantic must be noted even in such a brief review as this, although the new development has taken place in Canada. We refer to the purchase by the government of the Province of Manitoba, of the territorial Bell system for $3,300,000, payable in 40-year 4 per cent bonds, payable at par. The system is taken over bodily with the officials, as was done in England with the telegraphs. This is one of the results of the anti-Bell agitation in Canada, and may be followed by other unfortunate ventures of the same kind in the Dominion. It is indeed one of the most striking socialistic moves made on this side of the water, and follows a prolonged period of "government ownership" controversy. It will be interesting to see what efficacy and expansion the system enjoys under the new régime, but we make bold to assert that the free, individualistic, private ownership methods of the United States will prove, as hitherto, incomparably superior, and that such growth as we have just discussed, for 1907, can only be attained with a service free to change its front and its methods so quickly. We look for prosperous times in American telephony during 1908, because every incentive to development remains unimpaired.

THE STORAGE BATTERY.

The end of the year 1906 found the storage battery with its auxiliary apparatus in a high state of development, and it is therefore not surprising that the situation in this field has undergone little change during the past year. The most noteworthy event has been the active entry into the field of one of the large electric manufacturing companies, which has placed on the market a new storage battery together with the usual booster auxiliary. The plates are both of Planté formation while the booster is of the externally controlled type. One of the older companies has also brought out a new negative plate subjected to a special treatment after formation which, it is claimed, prevents any diminution in capacity even after years of arduous service, thus confining renewals to the positive element only. A new company has just entered the field with an element consisting of a lead core with active material on each surface held in place by porous earthenware plates. It is claimed that this construction results in a cell of relatively light weight and one practically indestructible. The general business for the year was good, and better than would naturally have been expected when the rapid use in the increase of steam turbine generating units is considered. The ability of the steam turbine to deliver power largely in excess of its normal rating, and also at a fraction of its rating, with but small changes in steam economy, diminishes the saving that a storage battery may be able to effect when working as a load regulator; and the preponderance of alternating-current over direct-current systems in recent installations, has prevented the battery business from keeping full pace with the growth and extension of the electrical industry generally.

The fact that the majority of the electrical equipments, and by far the greater kilowatt rating, installed in recent years, are alternating current, coupled with the desirability of having an electrical reservoir connected to the system, has led to the development of apparatus and devices, whereby storage batteries may be worked on alternating-current circuits. Some of these are highly ingenious and have proven successful. The current to charge the battery is received from the alternating-current mains and transformed into direct current, while the direct-current battery discharge is converted back to alternating current. Rotary converters adapted to work "inverted" are used in some systems, being interposed between the line and the battery; while in other systems, motor-generator sets are used. made up of an alternating-current machine coupled to a direct-current machine. In the latter case the alternating and the direct-current machine take turns in acting as the motor, depending on whether charge is going to the battery or a discharge from it to the line is taking place. Obviously when one of the two machines works as a motor, the other works as a generator, and the change from one condition to the other may take place almost instantaneously. Automatic field-controlling devices responding to the load changes of the system, cause the charge and discharge to take place with load variations, as in the case of externally controlled boosters with direct-current systems having regulating batteries connected to them.

It may be predicted that the use of storage batteries will be greatly increased in the next few years. This prophecy is predicated on the belief entertained by many engineers that the steam turbine marks only a transition period in prime movers which must give way to the internal combustion engine because of the superior economy of the latter. The characteristics of these two prime movers are practically antithetical. The gas engine has no overload capacity; it operates best when delivering a steady amount of power, and is liable to give trouble when worked on light loads. The storage battery affords the required flexibility in respect to variations in the external load while maintaining a constant load on the generating equipment, or as one writer on the subject has phrased it, "the storage battery is the natural consort of the gas engine." There is no question that an extended use of gas engines for driving electric generators will be attended by a correspondingly increased volume of business in storage-battery work.

PRIME MOVERS.

The experience of the year 1907 in power plant practice for central station work has served rather to confirm lines of development indicated during the past few years than to bring forward anything essentially new either in principle or mode of application. The general situation as regards fuels and

steam generators remains unchanged. Advancing prices of coal in various parts of the country and local coal famines have had the effect of increased attention to the problems connected with the economical use of low-grade or residual fuels, while in certain sections of the country the same conditions have caused a change of fuel from coal to oil. As already noted in these columns, the combustion of fuel oil has now become merely an economic problem, and if coal becomes more difficult to obtain than oil, or if its price rises above the margin for economic competition with oil, then the latter will naturally be adopted for steam generation; and during the past year exactly this change has occurred in certain parts of the country and especially on the Pacific Coast, where oil fuel has largely established itself as the standard fuel for steam generation. With regard to superheated steam, the status remains much as it has for the past few years. Steam superheated by 100 to 150 deg. has been accepted as a definite part of the program for turbine operation, and the leading makers of steam boilers now provide either specially designed superheating boilers or specially fired superheaters for the provision of steam superheated to such degree. On the other hand, the use of superheated steam in reciprocating engines is making but slight advances and the mechanical difficulties connected with lubrication and high temperature expansion appear to limit the use of superheat in such form of prime mover to an amount not often exceeding 20 to 40 deg.

With regard to the prime mover, the experience of the year has served the more definitely to establish the turbine as the typical steam prime mover for large units and for standard power plant practice. At the same time it is perhaps equally clear that this general status of the turbine has been reached not by virtue of any one characteristic alone, but as a result of the general summing up of its points of relative advantage and disadvantage. It has not demonstrated any superior thermal efficiency and its uniformity of rotative speed is met by quite satisfactory guarantees on this point by builders of reciprocating engines. The floor space required is distinctly less than for reciprocating engines, though the difference for the main turbine as compared with the main engine is to some extent offset by the larger space required for condenser and air pump. There still remains, however, some saving in space, and this feature, high and uniform rotative speed, resultant saving in size and cost of generator, excellent thermal economy, natural adaptation to overload conditions and general adaptation to the varied special conditions of electrical service, have together given to the turbine the status which it now occupies in the estimation of central station engineers. In point of size the past year has witnessed the advance to units of 10,000-kw rating, the dimensions for the turbine for such units being only 25 ft. x 15 ft. x 12 ft. or 27 kilowatts per square foot of prime mover floor area or 2.2 kilowatts per cubic foot of prime mover volume occupied. In small plants and for various special conditions, however, the reciprocating engine is holding its own, and until the present business depression began to make its influence felt, no industrial establishments were perhaps busier than the steam engine builders through the country. An interesting trend of practice may be noted in the matter of rotative speeds with Corliss or detaching valve gears. A few years ago a speed of about 100 r. p. m. was considered the maximum for engines with valve gears of this type. With the demand for higher speeds, especially in central station work, came first the four-valve engine with sacrifice of the distinctive features of the detaching gear and some consequent loss in economy. This move in large measure has been met by the designers and builders of detaching valve gear engines, who have shown that such gear may be operated with entire satisfaction at speeds of 120 r. p. m. as evidenced by large numbers of such engines in all parts of the country running at this speed. Still more recently, and especially within the past year, advances have been made to 150 r. p. m. and already a few engines with detaching valve gear are in operation at this speed.

In various parts of the country where municipal steam heating is in vogue, installations of specially interesting character have been made in which the heating and power plant are combined in one, the power unit serving as a reducing valve for the steam on its way from boilers to distributing mains, while at the same time toll is taken in the form of heat transformed into mechanical work and thence into electrical energy. It may be noted that in this manner the entire output of the boiler is sold, part in the form of heat energy in steam and part in the more highly specialized form of electrical energy. It may also be pointed out that in such case only so much fuel is chargeable to the power account as may correspond to the heat actually transformed into electrical energy; or in other words, an amount representing the actual fuel equivalent of the energy delivered to the switchboard. The remainder of the fuel charge must go to the heating account, thus making possible the development of power alone on the same financial basis as though we were possessed of an engine with 100 per cent thermal efficiency. With ordinary good practice the fuel thus chargeable to one kilowatt at the switchboard might be about one-third pound of coal instead of some two pounds as would be the case with the best practice of the day where the exhaust cannot be so utilized. Under circumstances permitting the sale in this manner of the entire boiler output of energy (except, of course, transmission and other secondary losses) the possibilities of saving so far as the fuel account is concerned are plainly apparent.

Regarding the internal combustion engine the situation has not changed in marked degree during the year. The prices of alcohol, gasoline and all such high-grade fuels rule them out of the field at once for all cases where the cost of power is an important item in the cost of the selling product. In the larger sizes, engines with ratings from 1000 to 4000 horse-power in small numbers are at work and much valuable experience is being acquired. Such engines are operating either on some form of produced gas or on gas derived from fuel oil. The chief difficulties have resulted from problems of speed control when driving alternators in parallel, and from difficulties inherent in the type of engine, especially in large sizes, such as internal deposits of carbon on valves and ignition apparatus, back firing, etc. The internal combustion engine in these large sizes seems, however, to be slowly making good, or in any event data are being very carefully gathered upon which further study may be made looking to the correction of the present difficulties; and with such further improvement this type of prime mover will acquire a status which will place it in most active and serious competition with existing forms of steam prime movers.

THE CENTRAL STATION.

While the past year has witnessed nothing revolutionary in the field of the central station, the retrospect brings out two features of importance which have characterized it—the increasing strength of the new business movement and the establishment of the principle of state regulation of electric lighting corporations as a public policy, which promises soon to become fixed in the statutes of all of the states. Happily there is as yet no indication that such regulation will seriously menace the real interests of the central station, and the example of Massachusetts shows that proper regulation can have the effect of safeguarding central station properties both from ruinous competition and from operations of high finance so fatal to the interests of the legitimate investor. While this journal has always viewed with askance propositions which would hamper the conduct of central stations as business enterprises, it has not been blind to the fact that the policy of withholding from the public all knowledge of central station finances has been largely responsible for the growth of the municipal ownership movement, and entirely so for the instances of property wrecked or their development checked, through improper financial manipulation. In so far as state commissions shall require the publication of accounts and a proper showing prior to new issues of stock and bonds, they will undoubtedly serve an excellent purpose; and while rendering the field less inviting to financial ability of a certain stamp, will undoubtedly make it more attractive for legitimate investment.

The recent awakening of the central station to the fact that it is not only a manufacturing concern but also a commercial retailer of its product, which should put forth every effort to overcome competition and extend the sale of its wares into new avenues, has already had an excellent effect, both financially and in increased electric lighting activity along all lines. The day should not be far distant when every central station will have been reorganized to accord with this new spirit, and the managements that will not heed its promptings will simply be inviting Fate to their undoing. To encourage this movement, during the past two years we have devoted a special department to it under the head "Central Station Sale of Current." This we shall continue, but as the use of this specific head has been misleading in that perhaps the matter printed elsewhere in an issue relating directly or indirectly to the commercial side of the central station exceeded that printed under the head, it will be dispensed with beginning with this issue. Owing to the vast preponderance numerically in this country of the central stations of smaller capacity, this journal has endeavored to print a correspondingly large amount of information of value in the management and operation of this class. Owing to lack of space here, a review of the situation with respect to the smaller central station is printed elsewhere, together with a discussion of immediate and remote prospects.

The outlook for these companies is by no means discouraging if they are in the proper hands. If they are not in the proper hands, there is good opportunity for young men who understand the business to take hold of them. To be sure, small companies do not offer to young men the same opportunities as the large ones, but we venture the opinion, based on past observation, that men making good records as managers of small companies do not go unnoticed when larger undertakings are on foot. The all-round experience gained in smaller companies is of the greatest value as a foundation for larger work. One of the greatest difficulties besetting the small company of to-day which is owned by local capitalists is to get the right kind of a man in the management. A manager should be judged by the results he can produce; and as the results produced by some of the successful small companies are now well known to all who regularly read these columns, there should be no rest until a property is in charge of a man who can duplicate these records.

THE FLAMING ARC LAMP IN AMERICA.

Up to the present writing, the flaming arc lamp in America seems to have occupied the place assigned to it by electrical prophets when it was first introduced in this country; that is, it has been principally used for advertising purposes, a few here and a few there. In the aggregate the number in use is considerable. They have been of such high candle-power in comparison with all other illuminants used on the street as to attract attention on this account, and also on account of their color. They have been extensively used for lighting the fronts of buildings, such as theatres and other places where it is desired to attract attention by the light. The flaming arc has also demonstrated its usefulness in billboard lighting. On account of its high efficiency, its downward light distribution, and the fact that the area of billboard covered by one lamp need not be very great, it is well adapted to this class of work. When it comes to the complete lighting of thoroughfares, however, the flaming arc has made little progress in this country, although we learn that it is receiving serious consideration in various quarters for special spectacular street lighting, and that before long we will doubtless have some notable installations in this country. For ordinary street lighting, however, the flaming arc is too large, and so much of its light is thrown downward that spaces between posts are dark by contrast. But there is a special class of street lighting for which it is fairly well adapted, and that is in the special lighting of down-town streets, where it is desired to produce an illumination enough out of the ordinary to be attractive, and where the property owners are willing to pay a relatively high price for striking results. In such cases, with lamp posts placed at very frequent intervals, and the lamps hung high up, the flaming arc, on account of its high efficiency, can undoubtedly produce a spectacular effect not obtainable at the same cost from any other illuminant now available. The downward distribution of light from the flaming arc is not so objectionable when lamps are placed close together as when they are placed one or two per block, provided the lamps are hung considerably higher than is usual with arc lamps. Could means be devised for spreading out the rather concentrated light distribution of the flaming arc lamp, the limitations accompanying its use would not be nearly so narrow. This problem is now being taken up, and it is to be hoped some successful practical methods can be worked out to accomplish this, and so increase the well-illuminated area that can be obtained from a flaming arc lamp. Apparently the only other method of solving the problem of securing even illumination from flaming arcs spaced 100 or more feet apart is to hang them at heights far in excess of any that are common in this country. Lamp posts 40 ft. to 60 ft. high may be very well for large areas, but for crowded down-town streets are excessively high. Hanging lamps on brackets from buildings do not seem destined ever to become popular in this country, although on many down-town streets the necessary height could be secured in that way.

To Lord Kelvin.

Peace and the grace of God abide with thee,
Fallen with weight of over-ripened days!
Thou canst not hear how men forbear to praise
For grief the world has lost thy majesty.

How shall we more exalt thy fame's degree,
Or to thy memory enduring raise
More lofty tribute than thy Learning lays
Upon thy tomb? What words of eulogy

Are needed more to save thy cherished name
From unremembered annals of the dead?
But with the great of every land we bow
In sorrow, while with loftiest acclaim
Thou to thine everlasting rest are laid
With crown of noble works upon thy brow.

Wilbur Morris Stine.

Burial of Lord Kelvin in Westminster Abbey.

Upon the initiative of the Royal Society, of which he was so long a member, Lord Kelvin was buried in Westminster Abbey on Dec. 23. A cable dispatch describes the event as follows:

England honored herself to-day in giving the last and greatest honor in her power to the mortal remains of her greatest scientist. With a ceremonial of a character never seen except at the funerals of her greatest men, Lord Kelvin's body was buried at noon in the nave of Westminster Abbey in a grave at the foot of Sir Isaac Newton's monument and close to the spot where a quarter of a century ago Charles Darwin was laid to rest. The coffin arrived from Scotland early yesterday morning and was placed in St. Faith's Chapel, where a short memorial service was held. The inscription on the coffin ran: "William Thompson, Baron Kelvin, of Largs, P. C., O. M., G. C. V. O., F. R. S., LL. D., D. C. L. Born June 26, 1824. Died Dec. 17, 1907."

During the first hours of to-day London lay in the darkness of night from an overhead fog, which drifted away, giving place to a gloomy, drizzling morning by 11:30, when the Abbey was filled to overflowing with ticketholders. Rarely has such a remarkable assembly of scientists and persons of distinction been gathered within its walls. Representatives of the various universities were there, wearing their academic robes. Representatives of foreign scientific bodies wore their decorations. Outside the Abbey stood a large gathering of the public. As the mourners assembled within Purcell's and Chopin's funeral marches were played. At noon the coffin was borne in procession through the cloisters, the choir singing. Twelve of the Abbey clergy were in the procession. The dean of Westminster, assisted by Canon Duckworth, officiated. The pallbearers were Lord Rayleigh, Admiral Sir E. H. Seymour, John Morley, Gaston d'Arboux, secretary of the Academy of Sciences of France; Sir Archibald Geikie, president of the Geological Society; Lord Strathcona, Prof. Crum Brown, of the Royal Society, Edinburgh; Prof. Sir George Darwin, University of Cambridge, master of Peterhouse College, Kelvin's old college; Dr. MacAlister, principal of the University of Glasgow; Sir J. Wolfe Barry, of the Institute of Civil Engineers, and Dr. R. T. Glazebrook, of the Institution of Electrical Engineers.

The Duke of Argyll represented the king. The Prince of Wales and the Duke of Connaught were also represented. Of the innumerable wreaths and other floral pieces only three were placed on the coffin, a cross from Lady Kelvin, a wreath from the Royal Society, and a bunch of flowers inscribed "A. and M." A delegation from Glasgow University included Sir W. Bilsland, vice-chancellor of the university and the bedellus of the university, bearing the mace, draped.

Cambridge was represented by Vice-Chancellor Sir John Gavey, Sir Henry C. Mance and W. H. Pierce. Alexander Siemens and other past presidents of the Institution of Electrical Engineers were present. Prof. Sylvanus Thompson represented the Italian Electrical Association, and H. F. Parshall and Joseph Wetzler the American Institute of Electric Engineers. Secretary John Ridgely Carter represented Ambassador Reid. The Russian and Italian Ambassadors were present in person. The German and Japanese Ambassadors were represented.

The Princess Louise, Lords Tweedmouth, Kinnard, Cecil and Manners, Sir John Bell, Lord Mayor of London, and Sir W. Crookes were present, together with representatives of the scientific societies of all the European capitals and of the great British engineering firms.

Additional Single-Phase Equipment for the New Haven.

The New York, New Haven & Hartford Railroad Company has decided to change the equipment of its New Canaan Branch from 600-volt direct current to 11,000-volt single-phase. This branch, which is about 7½ miles in length, extends from Stamford, Conn, on the main line, to New Canaan. It was equipped with direct-current apparatus about seven years ago. The service will be conducted by two motor-trains, each consisting of a 60-ton motor car and a 30-ton trail car. The motor car will be the standard 78,000-lb. coach of the New Haven Company, reinforced to carry the electrical apparatus, which is attached to the car body, and equipped with four General Electric motors of 125-hp nominal rating, of a recently developed type. No provision is being made for operating these motors with direct current, so that the equipment will be purely single-phase. The company is changing over the overhead construction of the line to a 11,000-volt single catenary, which will be used instead of the double catenary employed on the main line.

Mussoorie, India, Hydro-Electric Plant.

An interesting function was celebrated on Oct. 4 last when the foundation stone of the new power house for the hydro-electric scheme in progress at Mussoorie, Upper Punjaub, India, was laid in the presence of a distinguished company of military and civil residents. The stone was suspended from the center of a structure resembling an old battlemented keep, beautifully decorated with evergreens and ferns and emblazoned with the motto "Success to the Mussoorie Hydro-Electric Scheme," and the lowering tackle was so arranged that it could be set in motion by pulling a red, white and blue ribbon. The Hon H. W. Reynolds, government commissioner for the Meerut division, then spread the mortar with a silver trowel—a replica of the trowels used by the native workmen—and lowered the stone into position. The visitors inspected the works under the guidance of Mr. J. S. Pitkeathly, the representative of Messrs. Bruce, Peebles & Co., Ltd., of Edinburgh, who are the main contractors. The primary object of the scheme it to provide a plentiful and reliable water supply for the "Station." Springs which can be depended on for a quarter of a million gallons per day have been utilized by the municipality, but these are located at a level of 1500 ft. below Mussoorie itself, so that a powerful pumping plant was required. Owing to the abundance of water power in the district, a hydro-electric scheme was the obvious inference, and the contract was awarded to Messrs. Bruce, Peebles & Co., Ltd., about a year ago. A stream known as the Bhatta is being dammed and a duplicate pipe line 4500 ft. long runs down the hill to the power house, supplying water to the three 300-hp Pelton wheels, under 890 ft. head. Each Pelton wheel is direct coupled to a Peebles 150-kw high-tension alternator, the unit running at 500 r. p. m. Electrical energy is to be transmitted at 6600 volts by two overhead transmission lines, one running to the pumping station direct, and the other to the town of Mussoorie and then on to the pumping station, thus providing a loop system. The pumping station is being equipped with two 150-hp high-lift pumps, each driven by a Peebles induction motor and either unit being sufficient for the work; the

second being a reserve. The remainder of the load which the station can carry will be furnished by public and private lighting and motor applications. The public lighting by means of arc lamps in the main streets, and incandescent elsewhere is also already arranged, and there is no doubt that the remainder of the available power will early be taken up for private use There is ample scope for further developments.

Three-Phase Equipment for the Great Northern Railroad.

In addition to the three-phase locomotives which the General Electric Company will supply to the Great Northern Railroad, this company will build the entire electrical apparatus for the Cascade Tunnel equipment. The generating station, which will be located on the Manatchee River, 30 miles from the tunnel, will contain two 2000-kw, three-phase, 25-cycle generators driven by hydraulic turbines. It is interesting to note that arrangements will be made to take care of energy returned from three-phase locomotives on the down-grade.

Each locomotive will be designed for hauling a 500-ton train load up a 2 per cent grade at a speed of 15 miles per hour. The constant-speed characteristic of the three-phase induction motors will serve for controlling the train down-grade, as intimated above. By this means the possibility of break-down due to overheated wheel tires and brake shoes will be eliminated. Each locomotive will be equipped with three 325-hp motors mounted on articulated bogie trucks. The total weight will be 100 tons, all of which will be on the drivers.

The tunnel is approximately 2¾ miles in length with no ventilating shaft. There is a uniform grade east of 1.6 per cent in the tunnel section, making the difficulties of ventilation with steam locomotive operation a very serious factor, both from the standpoint of safety and operating efficiency. Aside from danger of poisonous gases of combustion, the interior of the tunnel has become so fouled with soot as to reduce the tractive effort of the steam locomotives now used by reason of the slippery condition of the rails.

The entire installation is under the supervision of Dr. Cary T. Hutchinson, who acts as consulting engineer to the Great Northern Railway. It is expected to have the road in operation in about one year, and work is already well under way on the water-power development, as well as the electrical apparatus.

Resuscitation from Electric Shock.

At the annual convention of the Society of German Electrical Engineers, held at Hamburg last year, the following rules for resuscitation from electric shock were adopted which were formulated with the co-operation of the Imperial Sanitary Council. These rules are practically identical, aside from the section relating to burns, with a set prepared for this Journal in 1894 by Dr. Augustus H. Goelet, and reprinted with revisions in 1901. A copy of these, suitable for posting or framing will be sent to any reader upon application.

1. If the subject is still under the influence of the source of electric shock, the first step is to withdraw him from the action of the current. In doing so, the following points should be observed:

a. The current, if possible, should be shut off by means of the nearest switch, or by disconnecting the wire in contact, or by withdrawing the wire by means of a dry, non-metallic substance, such as a piece of wood or by means of a rope.

b. The person performing this action should stand on a dry wooden board, dry cloth, or similar non-metallic support; or he should wear rubber shoes.

c. The person helping should insulate his hands by means of rubber gloves, a dry cloth, wearing apparel, or similar wrappings, and avoid any contact of his body with surrounding metal.

d. Efforts should be made to lift the victim from the ground and thus remove him from connection with the circuit. He should be carried by his clothing, touching of uncovered parts of the body being avoided as far as possible. If the victim is grasping the wire, the rescuer should loosen finger after finger with his hand, which should be insulated by means of rubber gloves or otherwise. In some cases it is sufficient to lift the victim from the earth, as the path of the current is thus interrupted.

e. In case of e. m. f.s not materially greater than 500 volts. an unskilled person may apply the preceding rules without risk to himself, but in the case of accidents from contact with wires of higher voltage, the power house or nearest sub-statiton should be notified as quickly as possible, and a doctor should be sent for.

2. If the victim is unconscious, a doctor should at once be summoned, and the following measures taken pending his arrival:

a. The room in which the victim lies should be well ventilated.

b. All close-fitting articles of clothing (collar, shirt, belt, trousers, underwear, etc.) should be loosened and the subject placed on his back, with a pillow made of blankets rolled under the head and shoulders, the head being allowed to lie somewhat lower.

c. If the breathing is regular, the subject should be carefully watched and not left alone. Fluids are not to be administered until consciousness has returned.

d. If respiration is absent or is very weak, artificial respiration should be produced. Before doing so it is necessary to remove any foreign substance (tobacco or artificial teeth) that may be in the mouth. Artificial respiration should be produced in the following manner: Kneel behind the head of the victim, with the face turned toward him, and grasp both arms at the elbow, drawing them backward over the head, and keeping them two or three seconds in that position. Then move them downwards, bend, and with the weight of the body, press the elbows against the sides of the victim's chest. After two or three seconds stretch out the arms again over the victim's head, repeating the stretching and pressing of the arms as regularly as possible about 15 times a minute. The movements should be executed slowly, counting in a loud voice between the intervals: 101, 102, 103, 104, etc.

e. If another helper is available during these exercises, he should grasp the victim's tongue with a handkerchief, draw it out forcibly and hold it fast. If necessary, the mouth should be forcibly opened with a piece of wood, the handle of a pocket knife, or similar means.

f. If several helpers are available, the exercises described under paragraph *d* should be carried out by two persons, each of them taking one arm and both executing the movements at the same time, counting in the intervals 101, 102, 103, 104, etc.

g. Artificial respiration should be continued until regular natural respiration has been restored; but even then the victim must be carefully observed for a time. Artificial respiration should not be abandoned for at least three hours.

h. If there have been injuries, such as broken bones, special care is needed in the care of the subject.

i. The lower part of the ankles and the feet should be rubbed from time to time with a rough, warm cloth or a brush.

j. After the return of consciousness, the victim should be left in a recumbent or semi-recumbent position and restrained from moving.

3. If the body of the victim has been burned, the following measures should be taken pending the arrival of a physician:

a. Before the person helping touches the burns he should most carefuly wash and brush his hands and the lower part of his arms with warm water and soap. It also recommended to rub them with a clean cloth saturated in alcohol, subsequent drying being omitted.

b. Red and swollen places should be covered with borax ointment on bandage-wadding, or with a bismuth bandage for burns, wrapped in turn with a soft bandage. Blisters are not to be broken, but pricked with a needle which has been heated

over an alcohol flame, and then covered with a bismuth bandage, bandage-wadding and a loose outer bandage. In case of charring and scabs, the wounds should be covered with several layers of bandage mull, over which wadding should be applied, the whole to be fastened by means of an outer bandage.

Transformer Litigation.

Justice Dyer, of the United States District Court of the Eastern District of Missouri, on Dec. 24 handed down a decision practically cancelling a previous award for damages in the transformer patent infringement suit of the Westinghouse Electric & Manufacturing Company against the Wagner Electric Manufacturing Company. Mr. Henry H. Dennison, special master in the patent infringement suit, has made an award in favor of the former company of $132,433.35, and this Justice Dyer reduced to $1 and costs. The court held that the plaintiffs in the suit had not shown that the infringement of the transformer at issue had produced the profit shown.

This litigation originated in 1900 by the institution of suit against the Union Carbide Company, of Niagara Falls, as users of certain transformers supplied by the Wagner Electric Manufacturing Company. Two patents were involved, one being a Westinghouse patent, which expired July 12, 1904, pertaining to details for cooling the working parts of a transformer, and the other a patent by Elihu Thomson pertaining to details of a water-cooling coil in the oil transformer. The court did not uphold the claim of infringement of the Thomson patent, but held that one claim of the Westinghouse patent was infringed. Prior to this decision, the Wagner Company discontinued the use of the details of construction covered by the claim sustained in the Westinghouse patent, and consented without contest to an injunction. Some months later, however, contempt proceedings were brought against the Wagner Company in the United States Court on the grounds that a modified construction employed by that company in its transformers still infringed the claim which had been held valid, but the court decided that the new construction was not covered by this claim.

CURRENT NEWS AND NOTES.

THE KELVIN ESTATE.—A cable dispatch from England states that the will of Lord Kelvin bequeaths all his real and personal estate to his wife. The exact amount is not given, but appears to be about $5,000,000.

BOSTON PREMIUM.—The Boston Elevated Railway Company has distributed to the 4000 employees who have been in the company's service for six months or longer the sum of $60,000. This is the fifth distribution of this nature by the company.

ELECTRICAL CONTRACTORS.—The Electrical Contractors' Association, of San Francisco, is to have a banquet at the Fairmont Hotel, on Jan. 18, and proposes to make the affair one of more than ordinary interest. The contractors of the city have had an unusually busy time during the past year.

TIDAL ENERGY IN GERMANY.—U. S. Consul-General Richard Guenther, of Frankfort, reports that a Hamburg joint stock company has purchased a large tract of land along the mouth of the Elbe at Cuxhaven, where power works are to be erected. The action of the ebb and flow of the tide is to be employed in generating electric energy to be used in factories. The works will also furnish electrical energy, it is said, to the town of Cuxhaven and other places in the vicinity. The capacity of the plant is put at 14,000 horse-power.

WIRELESS PHOTOGRAPHY.—A cable dispatch from Paris of Dec. 29, says: "Pascal Berjonneau, an inventor, exhibited to-day before the Postmaster-General and a number of persons interested in scientific investigation a new telephotography apparatus which can be adapted to the wireless system or to the ordinary telegraph wire system. He transmitted the picture of the postmaster without the aid of wires from one end of the hall to the other. The inventor says that distance does not interfere with the effectiveness of his method, and that it could even be used over submarine cables."

KELVIN EXERCISES.—It is proposed by the American Institute of Electrical Engineers to hold special exercises in honor of the memory of the late Lord Kelvin. This interesting meeting will probably be held in the Engineering Societies Building on Sunday afternoon, Jan. 12. President Stott has appointed a committee, with Mr. Percy H. Thomas as chairman, which is now arranging for speakers, music, etc. A great deal of interest is being manifested in this memorial meeting and the attendance is likely to be large, the hour being also a very convenient one for members living in the suburbs.

BELGIAN EXPOSITION.—An international exposition is to be held at Brussels in 1910 under the patronage of the King and the presidency of Prince Albert of Belgium. It will open in April, and will include 22 groups, one being electricity. A separate palace will be devoted to retrospective and modern exhibitions of lighting appliances of all kinds. In the machinery hall special attention is to be given to the use of small motors, and such as will assist in developing household industries. The exposition will occupy 200 acres adjoining the beautiful Bois de Cambre. The awards to exhibitors will be allotted by an international jury. The burgomaster of Brussels, Emile de Mot, is president of the executive committee, and Leon Janssen, general manager of the Brussels Tramways, is a member of it, while Albert Janssen, of the same system, is an assistant secretary-general of the Belgian section.

A. I. E. E. MEETING.—The next meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, Friday, Jan. 10, at 8 o'clock p. m. The following papers will be presented for discussion: 1. The New Haven System of Single-Phase Distribution, with Special Reference to Sectionalization. By W. S. Murray, electrical engineer, New York, New Haven & Hartford Railroad. 2. A Single-Phase Railway Motor. By E. F. Alexanderson, electrical engineer, General Electric Company, Schenectady. A special meeting of the institute will be held in the same auditorium Friday, Jan. 24, 1908, at 8 o'clock p. m. At this meeting the following papers will be presented for discussion: 1. Electrical Engineering Education. By Charles P. Steinmetz, chief electrician of the General Electric Company. 2. The Best Engineering Education. By Charles F. Scott, consulting engineer of the Westinghouse Electric & Manufacturing Company.

THE JUNGFRAU TROLLEY.—The electric railway up the Jungfrau appears to have become already the most popular mountain road in Switzerland. The highest station at present, the Eismeer (10,345 ft. above sea level), is still 3325 ft. below the summit. During the past summer and autumn 71,914 passengers were carried. This is somewhat less than the number in 1906, which was 74,545, but the difference was due to unfavorable weather. Work has just been begun on the tunnel, which is to continue the road to the Jungfraujoch, 700 metres below the summit. The time needed is estimated at four years. From the Jungfraujoch it was proposed to establish a service of coasting sleighs down the Aletsch glacier to the railway station at Fiesch, thus providing a highly romantic short cut from Interlaken to the Matterhorn region. It now seems probable that this part of the project will be carried out by another company, which has just applied for a concession to ascend the Jungfrau on the south side. Its plan is to have an electric railway from Brigue to the Aletsch glacier, and thence a sleigh service, with wire rope and electric power up the Jungfraujoch. The cost is estimated at only 3,650,000 francs, whereas the Jungfrau railway cost 7,000,000 up to the Eismeer station.

CHINESE TELEPHONY.—Active construction work has been begun on the telephone lines which are to connect Amoy with the other two cities of this prefecture, Tsuen-chou-fu, 50 miles to the north, and Chang-chou-fu, 30 miles to the west. The construction and operation of these lines are entirely under the control of the Chinese Government.

ILLUMINATING VARIABLES.—At a meeting of the Illuminating Engineering Society, Boston, on Dec. 10, the meeting was called to order by Chairman Campbell at 8:20 p. m. The chairman, after calling attention to the fact that the next session will be the annual meeting of the society, introduced Prof. Puffer, who presented an interesting paper on "The Variables of Illuminating Engineering." Considerable discussion followed, participated in by Prof. Puffer, Prof. Clifford, Dr. Bell, Messrs. Campbell, Codman, Hatch, Ware, Curry and others.

WIRELESS IN ALASKA.—Arrangements are being made by the army signal officers to purchase material for use in installing wireless telegraphy in Alaska. A 10 kilowatt station will be located at Nome and another of the same power at Fort Gibbon, where the Tanana joins the Yukon. At Fort Gilbert a three kilowatt station will be established, and the wireless stations at Fairbanks and Circle will be increased to the same power. Towers 175 ft. high will be erected in each place. It is expected to have the materials as soon as navigation opens. Lieut. E. A. Jeunet, Thirteenth Infantry, now in Cuba, will have charge of the wireless installation in Alaska next summer.

GLASS POLES.—It is stated that at Grossalmerode, a town near Cassel, Germany, a factory has recently been established for the manufacture of glass telegraph and telephone poles. The glass mass of which the poles are made is strengthened by interlacing and intertwining with strong wire threads. One of the principal advantages of these poles, it is said, would be their use in tropical countries, where wooden poles are soon destroyed by the ravages of insects and where climatic influences are ruinous to wood. The imperial post department, which has control of the telegraph and telephone lines in Germany, has ordered the use of these glass poles on one of its circuits.

FOREST DENUDATION.—At the recent meeting of the Boston Section of the American Institute of Electrical Engineers, Mr. M. O. Leighton, chief hydrographer of the U. S. Geological Survey, discussed the relation of forests to the development of water power. Mr. Leighton spoke in particular of the southern Appalachian region. He declared that a conservative estimate of the water power available in the region was at least 7,000,000 horse-power, that one-fifth of this sold at an annual rent of $20 per horse-power would yield to the government, if a national preserve should be made of the region, the equivalent of 3 per cent interest on a capital of $933,000,000. The denudation of the hills of their forest covering, which, he affirmed, is ever on the increase, costs the government every year several million dollars merely by the destruction wrought, besides the depreciation in land values. Prof. William L. Puffer presided.

CANADIAN POSTAGE RATES.—Newspaper publishers in the Province of Quebec have petitioned the Dominion postoffice department to restore the old rates on newspapers and magazines between the United States and Canada, a six months' trial of the new rates having proved the injurious effects to the Canadian press and people. The Montreal French Chamber of Commerce has also urged the repeal of the new regulations, and its committee appointed to look into the matter has reported that any restriction placed on the circulation of Canadian papers in the United States and in other foreign countries would prevent the country from being known and appreciated; that it would tend to neutralize the patriotic efforts of the Canadian press, and that it would unfavorably affect immigration to Canada as well as the repatriation of French Canadians. Persuaded that in the interests of colonization and commercial prosperity the country needed far more advertising than was given to it in the press, the Chamber of Commerce has requested the federal government to further such advertising by the creation of a commercial museum and the distribution of explanatory guides on the resources of Canada. The committee states also that the circulation of American magazines is of great advantage to trade and industry, both from a scientific and from a news standpoint, this having particular reference to the technical and trade press.

NEW YORK SUBWAYS.—It is understood that private ownership of new subways and the construction of them by private capital is regarded by the New York City Public Service Commission as the only means by which the city can obtain new transit lines within the next few years. The commission will recommend a change in the existing law that will allow of this in its annual report, which will be sent to the Legislature on Jan. 13. The change in the law which the commission will recommend is radical and may meet with considerable opposition. The recommendation has been decided upon only after long discussion among the commissioners and conferences between Gov. Hughes and Chairman Willcox. It is generally believed by all these men that no subways can be built in New York for some time to come unless the recommendation is carried out. Confident that the law will be amended as they suggest and within a short time after the Legislature meets, the commissioners will at once begin the preparation of plans for a new Manhattan subway, probably one up Lexington Avenue with a west side connection downtown. They will be ready to advertise for bidders for this and for the Fourth Avenue subway in Brooklyn very soon after the change in the law is made. It is probable, too, that they will suggest in their report that steps be taken at once to amend the constitution so as to exempt rapid transit bonds, to the end that the situation which now confronts them may not arise in the future.

AMERICAN WIRELESS TELEGRAPHY.—A correspondent of the New York *Evening Post* intimates that the U. S. Navy has no use for foreign wireless systems, having found one good enough at home. He says: "It would perhaps surprise the public to learn that, while practically every vessel of the United States Navy is equipped with wireless, there is not one installation of the Marconi system; nor is there a shore station on the Atlantic or Pacific Coast, or in the Philippines (belonging to the United States Government), equipped with this system, and yet the United States Government is to-day operating 43 wireless land stations. Now, in addition to the foregoing, if the public, when told that the system most largely used by the United States Navy was the Shoemaker, probably 99 out of 100 would ask, who is Shoemaker? This inventor is American born, and to-day under 30 years of age, and yet his system, though not publicly known, is held in the highest esteem by our government, which has tested every known wireless system. Of the 16 battleships making the Pacific voyage 11 were equipped with the Shoemaker system. The Bureau of Equipment of the Navy Department, in its published list last August of telegraph stations of the world, gives the following vessels as using the Shoemaker system: *Baltimore, Birmingham, Buffalo, California, Charleston, Chattanooga, Chester, Chicago, Connecticut, Denver, Des Moines, Don Juan de Austria, Elcano, Glacier, Indiana, Kearsarge, Kentucky, Louisiana, Maine, Maryland, Milwaukee, Montana, New Jersey, North Carolina, Ohio, Pennsylvania, Rhode Island, South Dakota, St. Louis, Tacoma, Virginia, Washington* and *Whipple.* And on land: Cape Cod, Cape Henlopen, St. Augustine, Jupiter Inlet, Culebra, W. I.; Farallon Islands, California; Point Arguello, Cal.; Island of Oahu, Hawaii, and others. In addition to these, numerous orders have been placed for the Shoemaker system from the Navy, War, and Treasury Departments, the latter for the revenue cutters."

ILLUMINATING ENGINEERING SOCIETY.—The next meeting of the New York Section of the Illuminating Engineering Society will be held in the United Engineering Societies Building, at 8:15 p. m., Thursday, Jan. 9. A paper by Dr. H. H. Seabrook, on "Light and the Eye," will be presented and discussed. A general invitation is extended to all interested in this subject to be present.

PANAMA CANAL POWER.—The Panama Canal Commission has asked bids for the construction of a central electric power plant and its equipment, which will be used to furnish power for eight cable ways. The latter are to be utilized in the excavations for and construction of the immense Gatun Dam. It is estimated that the total cost of the plant and the cable ways will be at least $800,000.

WIRELESS IN BURMA.—The Government of India has sanctioned the opening of wireless telegraphic communication for Burma between Margui and Victoria Point, with a station between Victoria Point and Maliwun. An annual guaranty of $13,823 will be given from the provincial revenues of Burma with respect to the combined system. The guaranty will be subject to reconsideration at the end of 10 years.

SECOND SIMPLON.—Advices from Berne, Switzerland, state that the construction of a second Simplon tunnel will be begun as soon as practicable, the National Council having approved the plan which already had passed the State Council. The construction will be undertaken by the administration of the Federal Railroads. The first Simplon tunnel, which was opened in 1906, cost $14,000,000. Electricity is to be the motive power.

MUNICIPAL OWNERSHIP.—The report of the National Civic Federation on "Municipal Ownership" has been issued by that body in three large volumes, bound in cloth, at a price of $10 for the set. These volumes contain a total of 2487 pages, and are undoubtedly the most complete record extant of data on this burning question, the facts, evidence and arguments having been laboriously collected on both sides of the Atlantic.

ST. JOSEPH MUNICIPAL SCANDAL.—At St. Joseph, Mo., on Dec. 17, a serious sensation was sprung when the grand jury of the Criminal Court inserted a probe into the affairs of the city electric light plant. It is alleged that "dummies" have been carried on the pay roll for the last three years, and during the past year the city has thus lost more than $16,000. In one department, where seven men were actually employed, a witness before the grand jury testified that 20 men had been charged for.

INDUSTRIAL SCHOOLING.—At Boston, on Dec. 19, some 200 men and women were present when the state commission on technical and industrial education began a public hearing at the state house on the expediency of the establishment of technical schools or industrial colleges. A large number of persons addressed the commission, and frequent applause attested the deep interest in the subject. Mr. Frank Parsons, representing the Breadwinners' Institute, was the first speaker, and he favored industrial colleges, as he believed that something must be done if the United States is to retain its position among the other nations of the world. Pres. Michael F. Sullivan, of the Lawrence board of trade, declared that labor is the worst paid branch of industry in the state, and he said that with industrial training there would be many a Lord Kelvin where to-day there is a $10-a-week clerk. John F. Crocker, president of the Boston Chamber of Commerce, was one of those who favored the establishment of a training school for workmen. Mr. M. W. Alexander, instructor in the trade school of the General Electric Company, favored school for workingmen, but he did not want it called a college. Henry Sterling of the Boston Typographical Union said the idea would have no warmer supporters than the members of trades unions if it can be shown beyond doubt that such schools will not result in a reduction of wages.

COPPER PRODUCTION.—The U. S. Geological Survey reports the production of copper in the United States in 1906 as 917,805,682 pounds. The production of 1905 was exceeded by 15,897,839 pounds, and the apparent rate of increase in 1906 was accordingly 1.76 per cent. This is an abnormally low increase, the gain in 1905 over 1904 having been 11 per cent, and in 1904 over 1903 nearly 16.40 per cent. The mine production for 1906 was 916,971,387 pounds. The bulk of the copper of domestic origin turned out by the smelters in 1906 was derived from approximately 19,743,000 tons of ore. Of the total ore tonnage approximately 5,021,000 tons, or about 26 per cent, were of sufficient richness or of so favorable metallurgical character as to be smelted without concentration. The remaning 14,722,000 tons were concentrating ores, from which were produced 2,085,000 tons of concentrates, the average concentration being slightly under 5 into 1. Of the 917,805,682 pounds of copper produced in 1906 by the smelters, 15,132,562 pounds were derived from the re-treatment of materials which had been subjected to reduction in previous years—namely, old slags, tailings, furnace linings, and the cleanings from old smelter sites. A great part of this material was slags and tailings, being consequently of low grade and profitable to treat only because of metallurgical advances.

CANADIAN LABOR LAW.—Last week at the notable banquet in New York of the National Civic Federation, President Eliot of Harvard University, in the course of an address, styled the Canadian industrial disputes investigation act, which went into effect on March 22, "the best piece of legislation ever adopted to promote industrial peace." As a result of the operation of this law several disputes between labor and capital, involving the operation of railroads, coal mines and steamship companies, which would have resulted in strikes or lockouts disastrous to the interests of the public, as well as causing losses to both capital and labor, have already been settled, in a number of cases without the cessation of operation for a single moment. The act is novel in that no settlement is compulsory, and strikes or lockouts are permitted only at the end of a given period. The methods by which results are obtained are conciliation, investigation and publicity. The industries to which the act applies are all mining properties and all agencies of transportation or communication, including railways, however operated; steamships, telegraph and telephone lines, gas, electric light, water and power works; in other words, public utilities and industries whose continuance in operation is a public necessity. The Minister of Law for the Domainion of Canada has the general administration of the act, and the Governor appoints a registrar of boards of conciliation and investigation, who conducts correspondence and keeps records of proceedings under the act. Any employer who declares or causes a lockout contrary to the provisions of the act is liable to a fine of not less than $100 nor more than $1,000 a day while the lockout exists. Any employee who goes on strike under the same conditions is liable to a fine of not less than $10 nor more than $50 a day while on strike. And any person who incites, encourages or aids an unlawful lockout or strike is liable to a fine of not less than $50 nor more than $1,000. "The main points covered by this act are, therefore," says President Eliot, "no change in wages or hours without thirty days' notice; no lockout or strike without a previous investigation of causes and demands by an impartial public authority, which secures complete publicity; and therefore no lockout or strike unless it has been carefully considered by the parties most nearly concerned through a period which can hardly be less than two months, and has been publicly debated for a period which, under ordinary circumstances, will not be less than one month, and may easily be more."

Municipal Conduit System of the City of Baltimore, Md.

WHEN, in 1890, the city of Baltimore undertook to force the removal of poles and overhead wires from the streets of the city, its experience was such as to indicate that the only way to control the situation was to provide the necessary conduits and require all wire-using companies to place their wires underground, all under the same conditions. After some preliminary skirmishing before the legislature of the state, an act was finally secured by the city in 1892 empowering the Mayor and City Council to appoint an Electrical Commission; but it was not until 1896 that an act was passed authorizing the city to issue its credit to the amount of $1,000,000. The ordinance submitting this appropriation to a vote was approved in the general election of November, 1897.

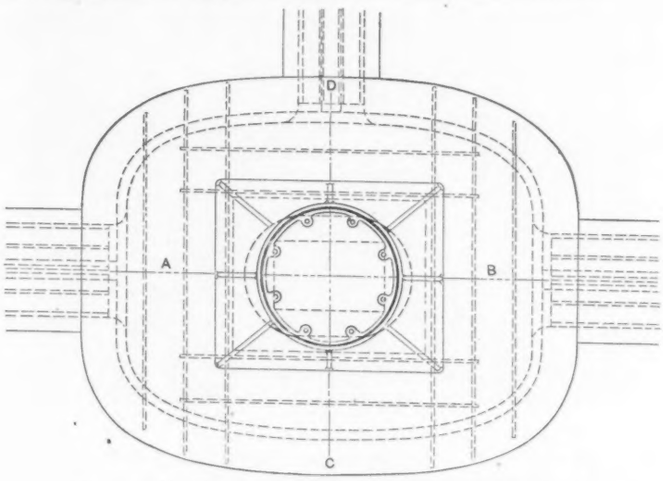


FIG. 1.—PLAN OF TYPICAL FORM OF BRICK MANHOLE.

The organization for the work was begun by the appointing of a chief engineer on Oct. 1, 1898, and from then to March 1, 1899, the time was consumed in the preparation of plans and the necessary details preliminary to the beginning of actual work. The ordinances were so framed that it was obligatory upon the commission to complete the conduits in certain defined districts of the city before notices could be issued for the removal of poles and wires from the streets. It was not, therefore, until Feb. 18, 1901, that the commission was in a position to issue the necessary notices of removal. The progress of the underground system was temporarily checked by the great conflagration in February, 1904. This, to a very large extent, affected the natural expansion of the system for a time, both by reason of the loss of service to the various companies involved and also of the rebuilding of conduit lines in the burned district, caused by changes in grade and street lines made by the Burned District Commission.

CHARACTER OF WORK.

The accompanying illustrations show the different classes of work in general. The conduit system as a whole is divided into two general parts; the trunk conduits, which are built for the purpose of carrying trunk lines and feeders, whether for telephone, telegraph, electric light, street railway, or other service, located generally in thoroughfares, feeding different sections of the city. These trunk lines are laid out to serve these several territories by the most direct and feasible route. The second part comprises the central or congested district of the city. As originally designed, this section was laid out to be served entirely underground with underground connections in each separate building. Extensions to this territory were afterward necessary by reason of the scattering of business houses after the fire and also by reason of the natural growth of the business district. Throughout the construction an effort has been made to follow the standard of that character of construction used in this country.

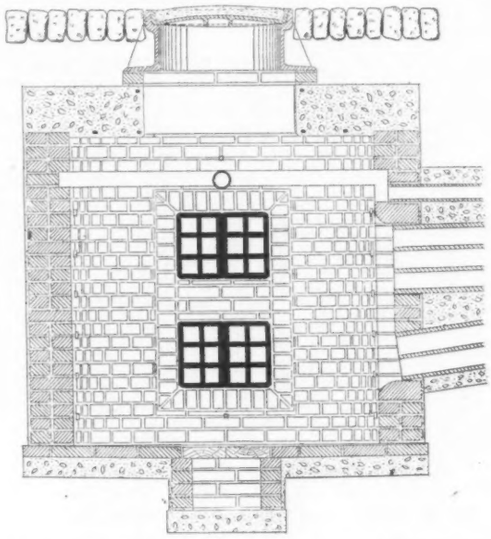


FIG. 3.—SECTIONAL ELEVATION OF BRICK MANHOLE.

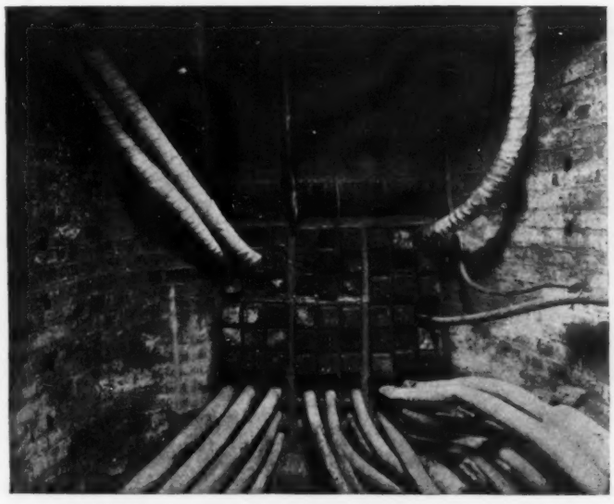


FIG. 2.—INTERIOR OF MANHOLE, SHOWING ARRANGEMENT OF HIGH-TENSION AND LOW-TENSION CABLES.

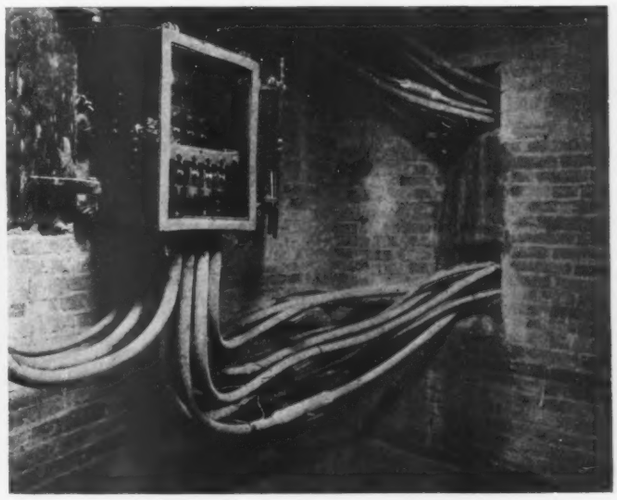


FIG. 4.—INTERIOR OF MANHOLE, SHOWING ARRANGEMENT OF FEEDER CABLES AND ALSO FEEDER BOX.

Vitrified terra-cotta conduit material has been used in all conduit lines. The conduit is enveloped in concrete. At first Rosendale cement was used exclusively, but now the concrete is mixed with American Portland cement. In 1899 the uniform thickness of the concrete envelope was 3 ins., except in the down-town streets, where the thickness was 4 ins. As the work progressed and experience was gained, the thickness

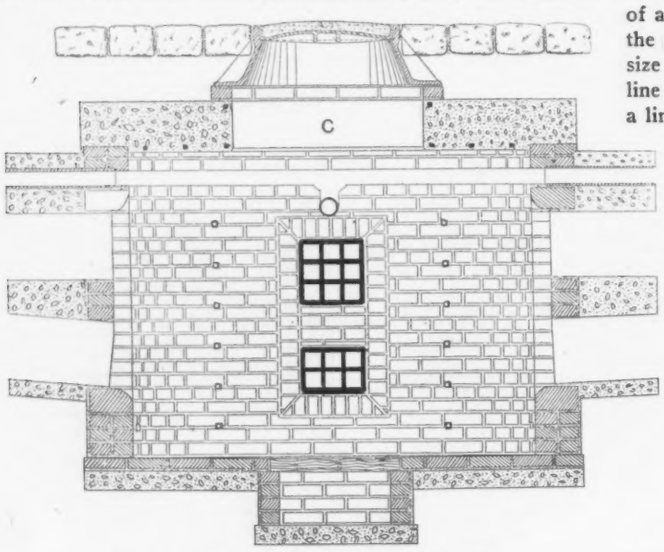


FIG. 5.—SECTIONAL ELEVATION OF BRICK MANHOLE.

of the protecting envelope was increased, the minimum sides and top being 4 ins., while the bottom varies from 4 ins. to 6 ins., and in numerous instances is reinforced with steel rods.

At the beginning of the work the joints in the conduit line were wrapped with burlap 6 ins. wide and saturated in liquid asphaltum compound. The commission recognized the difficulty of making air and gas tight joints and while a continued effort was made to secure such joints, the best that could be done was to minimize the entrance of gas into the conduit system. After some experimental work a composition of North Carolina pitch tar, refined asphalt and wax tailings was adopted and this has proven very serviceable. Cheese cloth has been substituted for burlap and the method of applying the wrapping to the joint is to paint the end of the conduit pieces with the hot

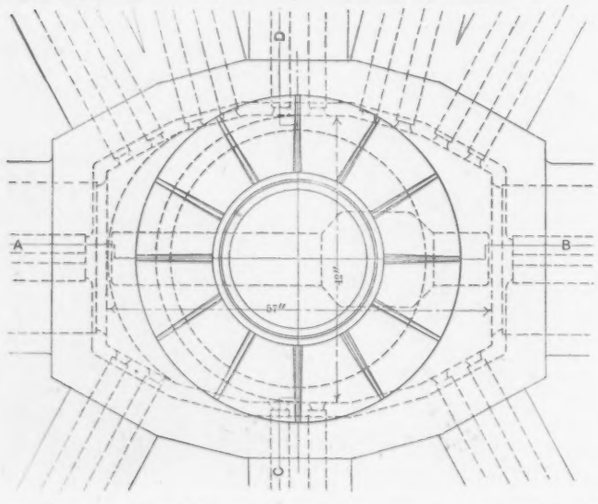


FIG. 6.—CONCRETE DISTRIBUTION BOX FOR ROADWAY OR SIDEWALK.

compound where the wrapper is to be applied, saturate the wrapper with the hot compound and apply it to the joint while it is still hot. While a joint made in this manner is somewhat expensive, it is believed that the results obtained have more than justified its use.

In the construction of all lines of conduit, fiber pipes, the number depending upon the importance of the line, are laid in the top layer of concrete for the purpose of providing ready means for arc lamp or similar connections from a point of the line remote from a manhole, without building an extra manhole or breaking the line of vitrified conduit. Manholes on trunk lines are all constructed of large size. A small conduit line of 12 ducts would have a manhole, elliptical in plan, of a minimum size of 5 ft. x 8 ft. and of a depth depending on the grade of the conduit, the minimum depth being 6 ft. The size of the manholes increases with the size of the conduit line up to a plan section of 7 ft. x 14 ft., which is suitable for a line of 81 ducts. On many important lines of conduit, where

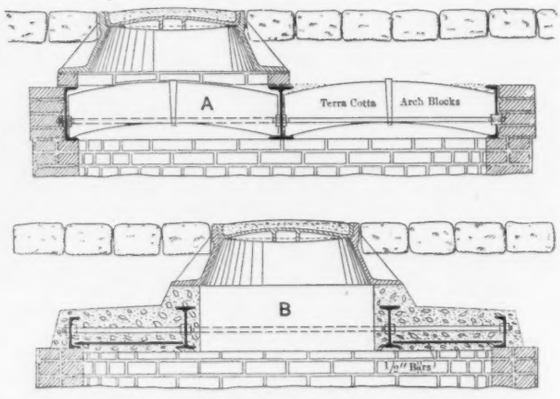


FIG. 7.—TWO FORMS OF ROOF CONSTRUCTION ON BRICK MANHOLE.

operations of workmen in the streets may possibly result in damage, the practice is to construct manholes of standard form but of larger proportionate width, building one-half of the manhole a distance in advance of the other half along the line of conduit as shown in Fig. 15, so that lateral connections may be made from either half of the manhole either way, without the necessity of crossing cables. The entire system is constructed so that no obstructions such as pipes, etc., pass through the manholes, which thus contain nothing except the cables for which they are built.

In the central districts of the city practically all lines of conduit were under-drained during construction and the presence of tide water and poor condition of the small house drains in the street necessitated special drainage provision to be made. The system of public sewers being somewhat limited in extent, and the storm water drains being on such shallow grades, it has rarely been possible to drain manholes by gravity. All manholes

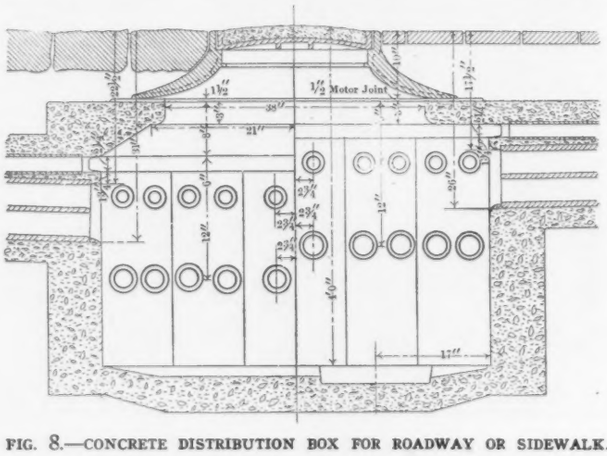


FIG. 8.—CONCRETE DISTRIBUTION BOX FOR ROADWAY OR SIDEWALK.

in the central districts are drained by means of ejectors operated by water pressure from the city mains. The practice is to construct a sump in the center of the floor in each manhole of sufficient size to contain a valve operated by a float which controls the supply of water into the ejectors. This is necessary to lift the water to a grade where it can flow by gravity.

The distributing conduits are uniformly made up of 10 ducts. The house connections are made with fiber pipe, each connection consisting of two 2-in. and two 3-in. pipes. In some of the original work 1½-in. pipes were used for service connection but the increase in size of service cables made it unwise to continue the use of this pipe. The system is ventilated throughout so that the conditions with respect to the presence of gas in the system are exceptionally good.

The manholes as constructed are roomy, admitting of cables being properly laid up and providing sufficient space for efficient splicing of new or repairs to old cables. The upper part of the manhole is reserved for electric light and power cables and the lower part for telephone and telegraph cables. The trunk conduits in the congested district are laid with an earth cover of from 2 ft. to 10 ft., depending upon the subsurface conditions during construction. The brick work of the manholes is brought up to within 22 ins. of the street surface and is covered with a roof composed of 10-in. I-beams and channels spaced 32 ins. center to center, except the span under the cast-iron frame, which is 40 ins. Special terra cotta arch blocks are sprung between the beams and are held by 1-in. tie rods. After setting the frame the whole roof is covered with concrete. Smaller size manholes are built with 9-in. walls and the larger size manholes are built with 13-in. walls laid in Portland cement mortar. The trunk manholes vary in roof area from 5 ft. x 8 ft. to 6 ft. x 14 ft.; the plan of the manholes being elliptical in form.

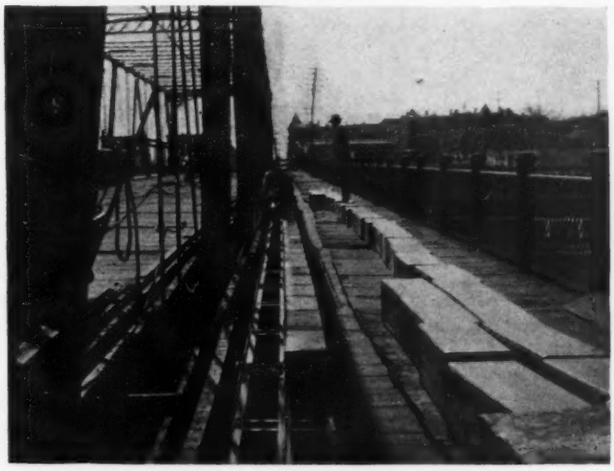


FIG. 9.—VIEW SHOWING METHOD OF PLACING CONDUITS ON GUILFORD AVENUE BRIDGE.

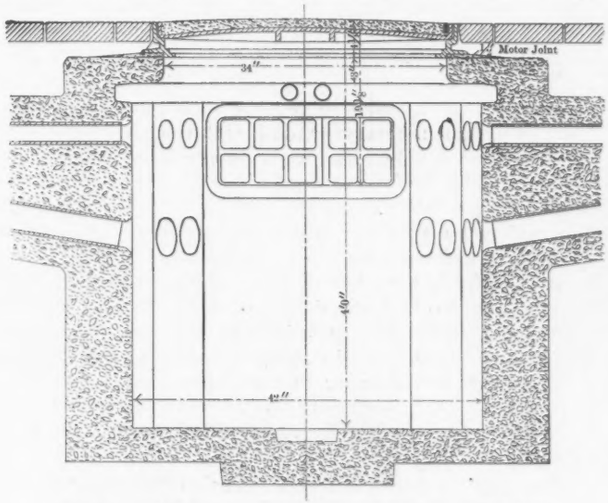


FIG. 10.—CONCRETE DISTRIBUTION BOX IN SIDEWALK.

The conduit lines of the distributing system are laid as closely to building lines as practicable; sometimes in sidewalks on a shallow grade, having an earth cover generally of only 19 ins. and broken every 60 to 70 ft. by service boxes with street covers. The distributing system consists of a 10-duct line laid 2 ducts deep and 5 ducts wide, encased in 4-in. Portland cement concrete. The service boxes in the sidewalks are circular in form and 36 ins. in diameter, having walls 2½ ins. thick and a cast-iron frame 5 ins. in depth to allow for sidewalk paving.

The service boxes in the street proper are built of brick with 9-in. walls and are elliptical in form. These boxes have a frame casting similar to that used on manholes, but smaller and lighter. At intersections of distributing lines, junction boxes are built similar to the brick service boxes, but of larger size. On service and junction boxes of all types the frame casting is set directly on the walls, no special roof construction being required.

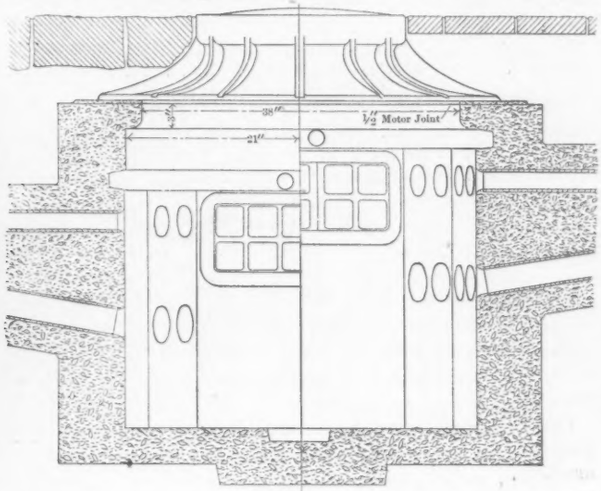


FIG. 11.—CONCRETE DISTRIBUTION BOX FOR ROADWAY OR FOR SIDEWALK.

Duct space is leased to the following companies: Baltimore & Ohio Railroad Company, Baltimore National Automatic Fire Alarm Company, Baltimore Electric Light & Power Company, Bartlett-Hayward Company, Chesapeake & Potomac Telephone Company, Consolidated Gas, Electric Light & Power Company; Crook-Horner Company, the Crown Cork & Steel Company, Jacob Epstein, Holmes Electric Protective Company, Maryland Telephone & Telegraph Company, Postal Telegraph-Cable Company, United Railways & Electric Light Company, United States Hydrographic Survey, University of Maryland, Western

FIG. 12.—MANHOLE DURING CONSTRUCTION.

Union Telegraph Company; conduits being also set apart for the municipal lines. Five of these concerns operate isolated plants and use the conduit system for electric light and power wires. The rate for the use of conduit space covered by lease and payable semi-annually is as follows:

1 to 5000 duct ft. inclusive.....7 cents per duct ft. per annum
5001 to 25,000 duct ft. inclusive.....6½ cents per duct ft. per annum
25,001 to 50,000 duct ft. inclusive.....6 cents per duct ft. per annum
50,001 to 100,000 duct ft. inclusive.....5½ cents per duct ft. per annum
100,001 duct ft. and over.....5 cents per duct ft. per annum

No limit is placed upon the voltage of conductors to be used in the duct space. All cables are properly tagged with the name of the owner, the number of amperes, the character of the current, and the potential at which they are operated. The cables, no matter what the service, are fitted with proper protective devices where they connect to overhead lines or leave the conduits.

For continuous service, cables with a carrying capacity not greater than 1500 amperes per sq. in. of conductor for paper insulation, and 1200 amperes per sq. in. for rubber insulation are used. Voltmeter tests are made to determine in which manholes it is necessary to bond cables to the street railway return system in order to prevent electrolytic action. The conductors are divided into five classes; Class I, conductors carrying a very low potential, such as telephone, telegraph and signalling wires; Class II, conductors carrying a current at potentials up to 220 volts, including the commercial 110-volt, 3-wire system of distributing mains; Class III, conductors operating under a potential of between 220 and 1200 volts; Class IV, conductors operating under a potential between 1200 and 6600 volts; Class V, conductors operating under a greater potential than 6600 volts. Insulation resistance for the various classes in megohms-per-mile is given in the accompanying table. These, however, are only relative values, for while high resistances may be obtained in dry paper-insulated cables, an equally good or better commercial cable is often used having saturated paper insulation, the effect of which is to reduce the initial insulation resistance.

	Class 2.	Class 3.	Class 4.	Class 5.
1. Good	350	400	800	1200
2. Fair	175	200	500	800
3. Bad	70	100	300	500

A cable having an insulation resistance greater than the maximums given is considered in good order. Below the minimum as given, the cable must be given attention, and if the deterioration has been rapid the fault must be found and corrected at the point so found, the use of the cable being discontinued until the fault is corrected. In any event, below the limits noted above, the cable is considered as being defective and repairs must be made. Should the insulation resistance drop below an amount equal to three megohms per mile per 100 volts, the cable is not considered safe, and its use is ordered discontinued until the efficiency shall have been brought up to the standard of the requirements already noted.

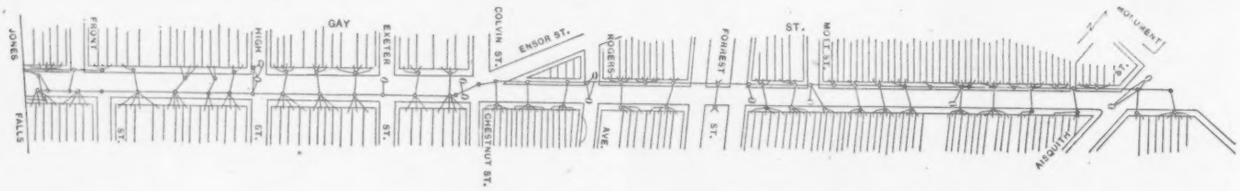


FIG. 13.—ARRANGEMENT OF DISTRIBUTING CONDUITS.

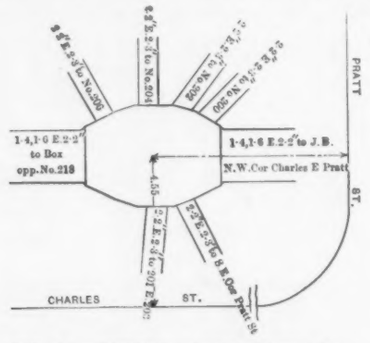


FIG. 14.—CONCRETE DISTRIBUTION BOX.

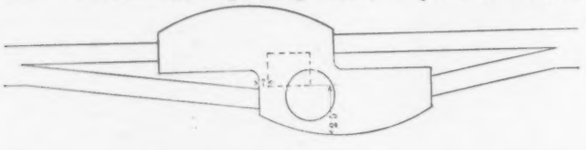


FIG. 15.—CONCRETE MANHOLE FOR PARTIAL SEPARATION INTO TWO HALVES.

Before allowing any of its employees to enter a manhole, the lessee must first make sure that there is no danger due to the presence of gas in the manhole. A sufficient number of hand-blowers must be provided to keep up the circulation of air while men are in the manhole. While the work is in progress, should there be danger of driving gas into other manholes in which work is not being done, such manholes must be opened and suitably protected by a guard at least 3 ft. high surrounding the opening.

In order to prevent the sifting of dust into the opening a sheet-iron combing is provided by the electrical commission for holes in which repairs are being made. The commission requires each lessee to provide a watchman on the surface at each manhole opening to protect traffic on the street. No lamps requiring flames are permitted in the manholes. Spelter used for wiping joints of the lead covers of cables is not permitted to be lowered into a manhole when the spelter is excessively hot.

The separation of the two classes of cables by a horizontal rather than a vertical partition was adopted for two reasons. In the first place, a vertical longitudinal division wall would be satisfactory for through manholes. As, however, the city's conduits are interconnected at every available point, it would be a matter of difficulty to provide an outlet for cables in order to secure an entrance into a branch conduit. There is no difficulty from this, however, when the manhole is divided into an upper and a lower compartment. Splices and connections on electric light cables are much simpler and more quickly made than splices on telephone cables, which, being composed of 100 to 400 separate conductors require more time and care. It was principally for this reason that the latter class of cables were assigned to the lower ducts and the whole manhole floor on which to handle them in splicing or repairing. The practical result of this method of separating the two classes of cables is the same as would be the case with two separate manholes, secured at less cost, occupying less street room and reserving the total head room for the more difficult work on heavier cables.

The system as now constructed comprises 6,661,000 duct-feet, the average number of ducts in the conduit lines being about 12. There are underground connections into 4154 separate buildings and the number of feet of cable of all kinds installed is 1,704,628.

Mr. Charles E. Phelps, Jr., is the chief engineer of the Electrical Commission, which is composed of the mayor, city register and president of the Board of Fire Commissioners.

Lighting of the New Plaza Hotel.

By H. THURSTON OWENS.

THE latest addition to New York City's list of magnificent hostelries is the Plaza Hotel, which represents an outlay of nearly $13,000,000. The hotel stands upon the west side of the square known as "The Plaza" at the intersection of Fifth Avenue and Fifty-ninth Street. It occupied the entire block between Fifty-eighth to Fifty-ninth Streets, and is surrounded on the west and south by residences, the most prominent being the one owned by the Vanderbilts; to the east is the Hotel Savoy and the Hotel Netherlands, and on the north is Central Park. The building is of early French Renaissance style of architecture. Its height is 19 stories, including basement and sub-basement. It was erected in about two years, which is considerably less time than is usual for buildings of its size and character.

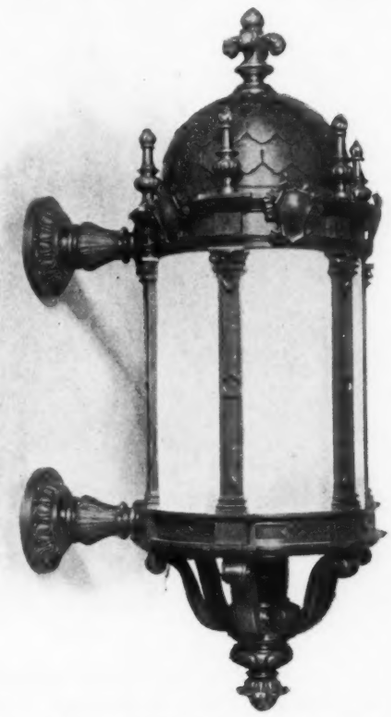


FIG. 1.—OUTSIDE BRACKET LANTERN.

The electric plant consists of four units, with a rating of 1100 kilowatts. The installation consists of 320 horse-power in motors and the equivalent of 17,000 16-cp lamps. The full load ranges from 3900 to 4900 amperes, and the day load is about 2600 amperes. The voltage used is 120.

Electricity is used for lighting, ventilating, driving machinery and for cooking in the grill-room. Gas is used for cooking, lanudry irons, gas logs; all of the corridors are piped for gas for emergency use, the equipment consisting of open-flame burners. The entire fixture installation, exclusive of wiring and piping, cost approximately $105,000, and over one-half of this amount was spent upon the fixtures on the ground floor, and outside of the building.

That the lighting installation has unique features is apparent before one enters the building, for instead of lamp posts there are 27 bracket lamps hung upon the building. These lamps, which are shown in Fig. 1, are made of bronze with clear glass sides, and are equipped with "Meridian" 40-cp lamps placed upright, with prismatic reflectors at the base of the bulb. The reflectors are to be removed, as they are not necessary and do not look well. If frosted glass were used in these lanterns the effect would be greatly improved.

There is a carriage entrance on Fifty-eighth Street, and one on the Fifth Avenue side, and just inside of these entrances there are two bracket lamps, as shown in Fig. 2. These are copied from an old-style English coach lamp, and are made of bronze, with clear glass and etched border, and equipped with "Meridian" 20-cp lamps.

Between the columns of the Fifth Avenue entrance there are five pendant frosted ball fixtures, enclosing ten 16-cp clear lamps. Upon the balcony over this entrance there are six bronze standards, each equipped with five frosted ball globes enclosing one 32-cp clear lamp. These standards were installed solely for architectural reasons, and a very successful result has been attained. They are shown in Fig. 3.

Over the main entrance, on Fifty-ninth Street, is a magnificent bronze and glass marquise, from which are suspended nine handsome lanterns of bronze and frosted glass, as shown in Fig 4, each being equipped with one Gem 100-cp clear lamp. In addition to the lanterns there are 27 16-cp clear lamps placed pendant under the same. The effect here would be much improved were frosted instead of clear bulbs used.

This entrance opens directly into the reception hall or lobby. This room, which is shown in Fig. 9, is 54 ft. wide, 32 ft. deep and has a height of 22 ft.. It is finished with marble walls of white and gray tints, the ceiling being white. These colors are somewhat relieved by the gold capitals of the pilasters, the gold fixtures, and the soft colors of the upholstering and rugs. The fixtures, of which there are 14, are chandeliers, with all of their ornamental features above the light source, which consists of five 20-cp "Meridian" lamps pendant, the lower half of the bulbs being frosted. The most impressive feature of this room is the illumination, which is brilliant, but well diffused and pleasing. It is possible to read anywhere in the room, which is rarely true of hotel lobbies.

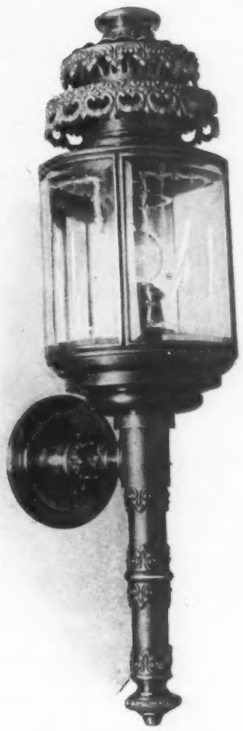


FIG. 2.—LAMP AT CARRIAGE ENTRANCE.

FIG. 3.—OUTSIDE STANDARD ABOVE PORTICO.

The corridor which extends around the building is 10 ft. wide

and of the same height and general character as the lobby. The chandeliers are similar in design and identical in equipment with those in the lobby. This fixture is shown in Fig. 7, excepting that the beaded ball lamps were not used in the installation.

The principal rooms on the ground floor in addition to the lobby are the dining rooms, of which there are two; the tea room, café and bar. The corridor leads to all of these rooms, and the general effect is large and commodious.

FIG. 4.—MARQUISE LANTERN.

FIG. 6.—GRILLE CHANDELIER.

FIG. 7.—CORRIDOR CHANDELIER.

At the west end of the corridor is the bar. This is an interior room 52 ft. x 40 ft. and 24 ft. high, and has dull-colored panelled walls with yellow painted ceiling. The lighting equipment consists of one central bronze chandelier, five brackets and eight ceiling clusters. The chandelier has 15 16-cp frosted ball lamps, and each of the brackets and the clusters five 16-cp lamps of the same pattern. In addition to the above a most pleasing effect is produced by the illuminated mural paintings in the alcoves over the bar. The lamps used are of the silvered reflector type.

The main dining room, which is on the Fifth Avenue side, is 68 ft. x 48 ft., and the same height as the corridor. It is exquisitely finished in pure Louis Sieze style, the colors being cherry, gold and white. The only lighting fixtures are ten chandeliers, finished in old gold, trimmed with crystals, the lamps being entirely enclosed. In each chandelier there are five 16 and 11 4-cp clear tubular pattern bulbs. This room is shown in Fig. 10, but no photograph could reproduce with justice the beautiful result. The Fifty-eighth Street dining room is slightly smaller, being 48 ft. x 54 ft., but the design and equipment are identical. The chandeliers in this room number eight. These rooms are divided by means of a temporary glass-partitioned hallway 14 ft. wide, in which there are two more chandeliers. By removing these partitions a room approximately 50 ft. x 130 ft. is formed, which is lighted by means of 20 chandeliers.

Across the corridor from the main dining room is the tea room, or, as it is sometimes appropriately called, "Lounge," for it is agreeably informal in contrast with the dining room. It is 70 ft. x 48 ft., of the same height as the adjacent corridor except for the central glass dome. This room, which is in the center of the building, is finished in marble of dull gray color, the glass dome being of soft green and yellow tints. Above the dome are 120 16-cp clear lamps. There is a profusion of plants and flowers here, which, unfortunately, hide the lighting standards, of which there are eight. These are particularly worthy of notice, as they are Italian Renaissance candalabrum, being an exact reproduction of the original at the National Museum, at Florence, Italy, by the celebrated sculptor, Valerio Cioli. The original is about 5 ft. high, while the copies are 8 ft. They are equipped with 12 16-cp 3⅛-in. frosted ball lamps. These fixtures were cast by means of the "Cire Perdu"

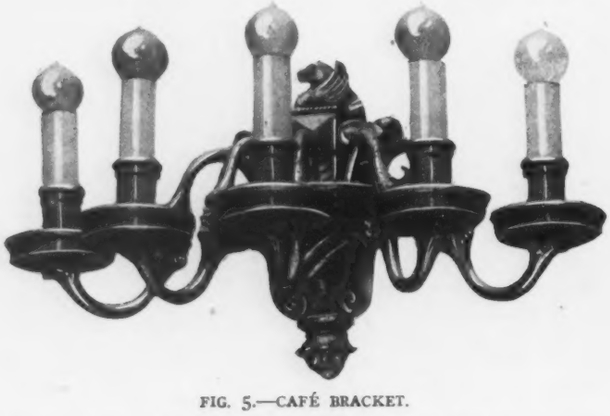


FIG. 5.—CAFÉ BRACKET.

FIG. 8.—GRILLE BRACKET.

FIG. 9.—LOBBY OF THE NEW PLAZA HOTEL.

FIG. 10.—MAIN DINING ROOM OF THE NEW PLAZA HOTEL.

ILLUMINATION IN ONE OF NEW YORK'S LARGEST HOTELS

process, which is used extensively in Italy, and are evidence of the fact that this class of work can be done successfully in America. They are of antique patina finish and are shown in Fig. 18.

Diagonally across the corridor from the tea room is the café, with windows on Fifth Avenue and of Fifty-ninth Street. It is wainscoted in dark oak, with tapestries and olive-green curtains, its dimensions being 69 ft. x 38 ft. The room has a dark, barrel ceiling, across which are four heavy beams, their height from the floor being 20 ft. and the height between the beams 24 ft. 6 ins. There are two dark bronze chandeliers suspended from each of the beams, making eight in all,

FIG. 11.—CAFÉ CHANDELIER.

FIG. 12.—BANQUET ROOM BRACKET.

and 13 bracket lamps of similar finish. Each of the chandeliers is equipped with 20 16-cp frosted ball lamps, and the brackets with five lamps of the same style. These fixtures are illustrated in Figs. 5 and 11. That the height and color of the rooms affect the illumination is very striking if one compares this room with the grille room, which is directly underneath and of practically the same dimensions in square feet. The grille room is 72 ft. x 38 ft. x 12 ft., with an alcove 66 ft. x 12 ft. x 8 ft. It has white enameled painted walls, white ceiling, and white enameled chairs upholstered in black leather. The lighting installation consists of ten chandeliers equipped with eight 16-cp frosted ball lamps and ten brackets with three 16-cp frosted ball lamps. These are shown in Figs. 6 and 8. Further comparisons between these rooms give the following results, the alcove of the grill room not being included:

	Cp.	Sq. ft.	Cu. ft.	Sq. ft. per cp.	Cu. ft. per cp.
Café	225	2622	60,306	11	268
Grille room	110	2736	32,832	24	298

Since the above comparison was made, orange-colored silk shades have been added to the fixtures in the grill room, as the illumination was too glaring and brilliant.

The other public rooms are located upon the second floor, and are the ballroom, banquet room and the state suite. The ballroom is Louis Quatorze style in white and gold, and is the largest room in the hotel, being 74 ft. x 65 ft. x 30 ft. There are balconies on three sides of the room, leaving an open space 60 ft. x 40 ft. The central balcony can be lowered to the floor level and used as a platform. There are two crystal chandeliers equipped with 150 16-cp lamps, (see Fig. 17), and 14 brackets with eight 16-cp frosted ball lamps. When the platform is used as a balcony the effect is very bad, as there is very little clearance between it and one of the chandeliers.

The banquet room is directly over the main dining room, but is naturally much smaller, being 48 ft. x 18 ft. x 14 ft., finished in light green. The only lighting fixture here are 12 "Regence" brackets equipped with five 8-cp frosted flame lamps, as shown in Fig. 12. The size of the brackets is not in keeping with the size of the room, being too small, and the amount of illumination insufficient, making table lamps necessary.

The furnishings of the private rooms are in keeping with the public rooms already described, but as the size, finish and equipment of these rooms are of such great variety, only a general description is possible in an article of reasonable length. The parlors and bedrooms of the expensive suites are equipped with chandeliers, candelabra, brackets and table lamps. Two styles of these parlor chandeliers are shown in Figs. 14 and 15, the former being equipped with nine 8-cp frosted flame lamps and the latter with eight 16-cp clear lamps. In all of the bedrooms for transients there are chandeliers and brackets, the former usually being pendant, as shown in Fig. 13, and the latter always upright. In all bathrooms there is one bracket, equipped with two 8-cp clear lamps and frosted shades. All other brackets have 16-cp lamps, as have nearly all of the chandeliers. The frosted shades are all sand-blasted inside, with polished exterior. The distance between the lowest point of all chandeliers and the floor is 6 ft. 4 ins. The chandeliers shown in Fig. 13 are the only pendant fixtures that are installed in the private rooms. Table lamps have silk shades and are equipped as follows: Parlor lamps with three 16-cp clear bulbs, and bedroom lamps with only one 16-cp clear bulb. All the corridors throughout the building are equipped with chandelier lanterns, with frosted glass. The floor above the ground floor, on which the ballroom and other public rooms are located, is used to a much greater extent than the guests' floors and there is one Gem 50-cp lamp in each lantern, the others being equipped with one 16-cp clear lamp. These lanterns are placed about 20 ft. apart and are shown in Fig. 16.

FIG. 13.—BEDROOM CHANDELIER.

FIG. 14.—PARLOR CHANDELIER.

The engine room and laundry, which are located in the subbasement, are equipped with arcs and incandescents. The former, which furnish the general illumination, are 5-ampere arcs, with dense, milky outer globes, and the latter, which are placed at points where additional light is necessary among the machinery, are clear 16-cp lamps. The kitchens are equipped

with Gem lamps, 50, 75 and 100-cp, with prismatic reflectors. The other service portions of the hotel are equipped with clusters of clear 16-cp lamps, horizontal, with white porcelain reflectors.

FIG. 15.—PARLOR CHANDELIER.

FIG. 16.—CORRIDOR LANTERN.

The stage and the ceiling above the lounging room are lighted by the Frink system of concealed lamps.

Increased knowledge of illuminating engineering has had much to do with the successful lighting of this modern palace, and those interested in other illuminants must work along similar lines or be hopelessly outdistanced. The success achieved is due to the progressive attitude of those who so aggressively advance the interests of that illuminant.

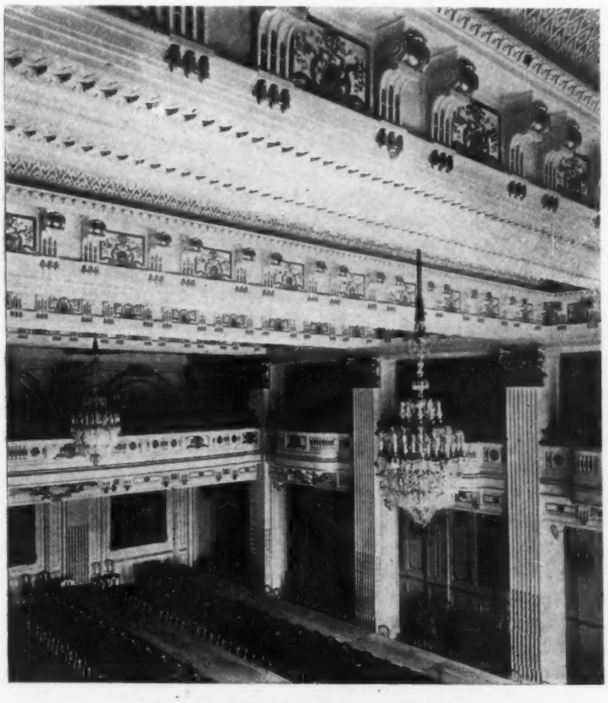


FIG. 17.—GENERAL VIEW OF BALL ROOM.

The photographs for this article were furnished by the manufacturers of the fixtures; the lobby, dining rooms, tea room, grille room and the outside of the building having been equipped by The Sterling Bronze Company and the other fixtures supplied by The Enos Company.

Single-Phase Motors for Central Station Service.

Whatever may be the source of energy, in the electric lighting industry as it exists to-day, lamps are always connected between two terminals, so that a lamp load is essentially "single-phase." The use of "single-phase" circuits is therefore necessary in some portion of the distributing system, although polyphase circuits may be employed in transmission. Thus the prevailing use of "single-phase" circuits by central stations is attributable to the character of the receivers rather than to any small economies that may be obtained by its use. However, it is believed that the disadvantages of single-phase circuits have often been over-estimated, and the advantages have sometimes been ignored.

Although numerous text books contain elaborate discussions of the relative amounts of copper required for single-phase and polyphase transmission systems, and almost invariably the conclusion is reached that of all systems the three-phase is the most economical in conducting material, yet the fact remains that the single-phase system under present operating conditions is the exact equivalent of the three-phase system as to the cost of copper and is preferable to it with respect to the cost of insulators for the line.

If the transmission lines could be so erected that the weakest point in the insulation becomes the air-space between two wires, then the various systems could be compared on the basis of the equality of e. m. f. between wires, on which basis the three-phase system requires only three-fourths as much copper as either the single-phase or the two-phase system. When, however, as is actually the case, the weakest point is found in the insulators themselves, then the various systems must be compared on the basis of the equality of the e. m. f. to the neutral point, on which basis all symmetrical transmission systems are equal in the cost of conducting material, while the single-phase is the cheapest to erect on account of requiring the least number of insulators. For example, if each insulator is designed, with the proper factor of safety, for a working e. m. f. of 10,000 volts, then on a transmission line using metallic poles (or with grounded neutral) the e. m. f. between wires in a three-phase system could be 17,300 volts, while in a single-phase system the e. m. f. could be 20,000 volts—the former system requires equally as much conducting material as, and 50 per cent more insulators than, the latter system.

FIG. 18.—TEA ROOM STANDARD.

The superiority of the three-phase over other transmission systems resides in the smaller cost for insulators as compared with the two-phase system, and in the less cost for generators and motors as compared with the single-phase system. In central-station work where the generating equipment is of the alternating type, polyphase alternators are frequently used, although the energy is distributed to the customers over single-phase or direct-current circuits. With almost no exception, central-station companies would find it more convenient to supply energy to single-phase rather than to polyphase or direct-current motors, provided the services were equally satisfactory from the several types of machines. It is evident, therefore, that from the very nature of the problem, central-station companies are favorably inclined toward single-phase motors. It is the object of the present article to discuss briefly the constructive features and operating characteristics of such types of single-phase motors as have been employed successfully in central-station service.

As intimated above, the single-phase motor has as its competitors the direct-current and polyphase motors. It may fairly be stated that there has never yet been produced a single-phase motor equally as simple in construction and as robust in performance as the polyphase induction motor, or equally as flexible and efficient in operation as the direct-current motor involving the same outlay for constructive material. It should not be inferred from this statement that the single-phase motor is excessively expensive, or in any respect unsatisfactory, but rather that its competitors have been developed to a high degree of perfection. Each of the many types of single-phase motors that have been produced possesses constructional details resembling either a poly-induction motor, a direct-current motor or a combination of the two. The writer is unaware of the existence of any single-phase motor the performance of which could not be improved by operating it as an ordinary direct-current or polyphase induction motor, after slight alterations are made to convert it into a machine of the proper type. However, from the standpoint of central-station service, single-phase operation is so far superior to polyphase or direct-current that the comparatively small disadvantages residing in the use of single-phase motors may be ignored in most cases.

In comparison with its polyphase competitors, the induction type of single-phase motor is less efficient in operation, and it requires auxiliary starting devices. The commutator type of single-phase motor is not so efficient as the corresponding direct-current machine and commutating difficulties are encountered under starting conditions. The early designers of single-phase motors found that the disadvantages in these machines are less prominent the smaller the rating, and hence the early single-phase motors were limited to low ratings. In fact, almost all of the early types of single-phase motors that attained success were used for driving fans. The plain series type of single-phase commutator motor as used for fans differs immaterially from the direct-current series motor except that the magnetic circuit is laminated. This type of motor operates better the lower the frequency, reaching the best performance when the frequency is zero—that is, with direct current. The higher the frequency, the greater is the iron loss, the lower is the power factor, and the poorer is the commutation. The fact that single-phase series fan motors have been used successfully with a frequency of 60 cycles per second, shows that the disadvantages mentioned are not insurmountable when the design problems are placed in competent hands.

The most difficult problem connected with the design of the induction type of single-phase motor resides in the lack of starting torque of this machine. Although perhaps not the most efficient, yet certainly the simplest, device for rendering a single-phase induction motor self-starting is the "shading coil," which consists merely of a single uninsulated turn of copper currounding a certain portion of each field pole. This coil serves to retard the initial production, and the subsequent removal, of flux within the area which it surrounds, and thereby gives to the resultant magnet flux around the air gap an irregular forward motion in the direction from the "unshaded" to the "shaded" portions of the field poles. The weak revolving field thus produced gives to the short-circuited rotor a torque sufficient to accelerate it to such a speed that the "quadrature" field produced by current in the rotor becomes of sufficient strength to augment the acceleration until the speed reaches a value slightly below synchronism. Since the load torque on a fan motor has zero value at starting, the "shading-coil" motor possesses the requisite torque-speed characteristic for fan motor service, and it has proved thoroughly reliable in this connection.

A refinement as to detail, with an accompanying increase in efficiency and decrease in simplicity, was found in building each "shading-coil" of several turns properly insulated, and aranging to open the shading-coil circuit under full-load speed. An additional improvement in the starting torque was obtained by connecting the shading-coil circuit in parallel with the main-field circuit during the starting periods. The maximum starting torque is obtained when the main coils and the starting coils are placed in electrical space-quadrature and are supplied with equal magnetomotive forces in electrical time-quadrature. The attempt to obtain the maximum torque at starting has resulted in the "split-phase" motor in which the current in the starting coil is displaced in time-phase from the current in the main coil by the introduction of resistance in the starting-coil circuit. This motor, which has been adopted for duty much more exacting than that of driving fans, will be discussed fully below.

One of the most interesting, and probably the most ingenious, of the schemes used for rendering a single-phase motor self-starting and simultaneously giving it excellent operating characteristics, was embodied in the type of machine constructed with projecting field-poles like a direct-current motor, and with both a direct-current commutator winding and an induction motor short-circuited secondary on the rotor, which was supplied with single-phase current and operated with certain synchronous motor characteristics. The sationary winding and the commutator winding were connected permanently in series. The machine started as a series motor and accelerated almost to synchronous speed as an induction motor. As the speed approached synchronism, the rectifying effect of the commutator winding, combined with a damping effect of the short-circuited winding, caused definite magnetic poles to be formed on the rotor, and the machine assumed many of the advantageous operating characteristics of a synchronous motor with a revolving field-magnet.

An interesting form of self-starting, single-phase motor was the single-brush commutator machine which was used by many manufacturers in the early days of the fan industry. The stationary field winding had no electrical connection to the revolving armature winding. The latter winding was similar in all respects to the armature of a direct-current motor, while the former resembled the primary winding of a single-phase induction motor. A single brush served to short-circuit an armature coil in such a position with respect to the field poles that the secondary current gave a torque to the rotor. As only a small portion of the armature winding was in use at any one instant, this machine required an excessive amount of constructive material for each unit of effective output.

A machine which differs immaterially in constructive details from the one just described, but which represents an enormous improvement in operating characteristics, is the so-called "repulsion motor" which is provided with two brushes (per pole-pair) short-circuited upon themsleves. It is a curious fact, easily verified experimentally, that the torque of the latter machine is in a direction reversed from that of the former; that is to say, the repulsion motor possesses as a disturbing feature the one feature that makes the other machine operative. However, the brushes on the repulsion motor are made narrow to minimize the negative torque, while on the other machine the brushes were made wide to obtain a good operating torque.

Seldom indeed are the repulsion motor characteristics, which are quite similar to those of a series motor, employed for continuous service; a single-phase machine which is started from rest as a repulsion motor is converted into an induction motor

when synchronous speed is approached by means of a centrifugal device which removes the brushes from the commutator and changes the armature into a squirrel-cage secondary by forcing a short-circuiting ring into contact with the commutator segments. The type of motor here outlined has proved equally as reliable in operation as the polyphase induction motor, and fully as robust as the direct-current motor.

Mention has already been made of the "split-phase" type of motor. In its performance under load this type of machine differs in no respect from the single-phase induction motor just described. In the "split-phase" motor, however, the rotor winding is the same under starting as under running conditions, while the auxiliary starting devices are located on the stationary member. The starting-coil circuit may be interrupted by hand, or the interruption may be rendered automatic by the use of a switch placed on the rotor and operated by centrifugal force.

The "split-phase" motor may be provided with two unequal primary windings placed in electrical space-quadrature, or with symmetrical two-phase windings; in either of these cases, under starting conditions, the current in one winding is displaced in time-phase from the current in the other as noted before, the displacement usually being obtained by inserting a resistance in the starting-coil circuit.

In some cases the "split-phase" machine is arranged as a symmetrically wound, three-phase induction motor, the displaced e. m. f. for the third lead being obtained indirectly from the supply system by connecting across the two main leads a resistance and reactance in series, the third lead being connected to the junction point of the resistor and the reactance coil. The starting torque can be greatly increased by substituting condensance for the resistance. When a condenser is available it can be left in circuit, so that the leading wattless volt-amperes taken by the condenser can act to neutralize an equal amount of lagging wattless volt-amperes for exciting the induction motor, and thereby to increase the power factor almost to unity. Referring exclusively to single-phase motors for constant-speed service, it may safely be stated that the best combined power factor, efficiency and output per unit weight for any known type of single-phase motor, can be obtained from the induction motor with a condenser across a "tertiary" circuit—ignoring the present lack of satisfactory inexpensive condensers for such use.

Although, as previously intimated, no single-phase motor now on the market is the equal in every respect to present-day direct-current and polyphase induction motors for constant-speed service, yet there are obtainable to-day several types of single-phase motors even more satisfactory than the polyphase and direct-current motors bought several years ago and still giving good service. In performance these machines are thoroughly reliable, and the efficiency is sufficient to meet the requirements of many industrial problems now confronting central stations.

Some Facts Regarding Metal-Filament and Carbon-Filament Lamps.

By George Loring.

From the standpoint of current, candle-power, total watts and watts per candle, tantalum and tungsten lamps are less susceptible than carbon-filament lamps to changes in electrical pressures. The resistance of the metal filament increases, whereas that of the carbon usually decreases with rise in voltage.

Following are tables showing the comparative results upon carbon, tantalum and tungsten filament lamps when they are operated at from 85 to 110 per cent of their normal voltage.

In glancing over the tables given it will be seen that with the exception of resistance the minimum and maximum points reached in performance when the e. m. f. changes, are nearer to that of normal with metal than with carbon-filament lamps. Whereas, at 85 per cent of normal voltage a carbon lamp's resistance is 100.24 per cent of that secured at normal voltage, that of the tantalum lamp is 95.5 per cent, and of the tungsten lamp 93.5 per cent. At 110 per cent of normal voltage the per cent of resistance to that at normal is 99.81 with a carbon lamp, 102.5 with a tantalum lamp, and 104 with a tungsten lamp.

On account of the different characteristics of the resistance of the carbon, tantalum and tungsten lamps the current is naturally affected in such a way that at 85 per cent of normal voltage it is reduced 15 per cent with carbon lamps, 11 per cent with tantalum lamps, and 9 per cent with tungsten lamps, and at 110 per cent of normal voltage the current of the carbon lamp is increased 10 per cent, of the tantalum lamp 9 per cent, and of the tungsten lamp 6 per cent.

CHANGE OF RESISTANCE WITH CHANGE OF VOLTAGE.

Percentage of Voltage to That of Normal.	Percentage of Resistance to That of Normal Voltage.		
	Carbon.	Tantalum.	Tungsten.
85	100.24	95.5	93.5
90	100.16	97	96
95	100.08	98.5	98
100 (Normal)	100	100	100
105	99.91	101	102
110	99.81	102.5	104

CHANGE OF CURRENT WITH CHANGE OF VOLTAGE.

Percentage of Voltage to That of Normal.	Percentage of Current to That of Normal Voltage.		
	Carbon.	Tantalum.	Tungsten.
85	85	89	91
90	90	93	93.5
95	95	97	97
100 (Normal)	100	100	100
105	105	103.5	103
110	110	107	106

VARIATION OF CANDLE POWER COMPARED TO VARIATION OF VOLTAGE

Percentage of Voltage to That of Normal.	Percentage of Candle Power to That of Normal Voltage.		
	Carbon.	Tantalum.	Tungsten.
85	41	50	55
90	56	64	67
95	75	80.5	82
100 (Normal)	100	100	100
105	131	123	119
110	168	148	141

PERCENTAGE OF CHANGE IN TOTAL WATTS COMPARED TO PERCENTAGE OF CHANGE IN VOLTAGE.

Percentage of Voltage to That of Normal.	Percentage of Total Watts to That of Normal Voltage.		
	Carbon.	Tantalum.	Tungsten.
85	72.5	75.5	77.5
90	81	83.5	84
95	90	92	92
100 (Normal)	100	100	100
105	110.5	109	108
110	121.5	117.5	117

WATTS PER CANDLE OF LAMPS OPERATED AT 85 TO 115 PER CENT OF NORMAL VOLTAGE WHEN MEAN HEMISPHERICAL CANDLE-POWER IS CARBON 3.1 WATTS PER CANDLE, TANTALUM 2.1 WATTS PER CANDLE, AND TUNGSTEN 1.25 WATTS PER CANDLE.

Percentage of Voltage to That of Normal.	Watts Per Mean Hemispherical Candle Power.		
	Carbon.	Tantalum.	Tungsten.
85	5.5	3.18	1.76
90	4.5	2.73	1.57
95	3.73	2.39	1.4
100 (Normal)	3.1	2.1	1.25
105	2.61	1.86	1.13
110	2.23	1.66	1.03

The resistance of tungsten and tantalum lamps being less than that of carbon lamps when operated at a voltage lower than normal causes their current, as has been shown, to be higher respectively, and their candle-power must necessarily be greater. The carbon lamp gives 41 per cent, the tantalum 50 per cent, and the tungsten 55 per cent of its rated candle-power when operated at 85 per cent of normal voltage, and 168 per cent, 148 per cent, and 141 per cent candle-power, respectively, when run at 110 per cent of correct voltage. This shows that the light delivered by metal-filament lamps is much less affected than that from celulose-filament lamps by variation of voltage. It is a matter, however, which cannot be brought out too strongly. Referring to the table showing variation of candle-power compared to variation of voltage, it is shown that a drop of 5 per cent from normal voltage causes a reduction of 25 per cent in the illumination received from the carbon-filament lamp, 19.5 per cent in that received from the tantalum lamp, and only 18 per cent in that given by the tungsten lamp. A rise of the same percentage above normal causes an addition to candle-power of 31 per cent with carbon lamps, 23 per cent with tantalum lamps, and 19 per cent with tungsten lamps.

The increase in total watts is less with metal than with carbon-filament lamps operated above voltage. Burning at an elec-

trical pressure 5 per cent high the energy consumed is increased 10 per cent in a carbon lamp, 9 per cent in a tantalum lamp, and 8 per cent in a tungsten lamp.

The watts per candle do not vary as much with tantalum and tungsten lamps as they do with carbon when the voltage is changeable. Not only are the metal-filament illuminants far more efficient, but their percentage of change in watts per candle is much less when compared to carbon-filament lamps when run at a fluctuating voltage. Taking the specific consumption of the cellulose lamp as 3.1 watts per candle, the tantalum as 2.1 watts per candle, and the tungsten as 1.25 watts per candle at 100 volts, the respective specific consumptions would be 5.5 watts per candle, 3.8 watts per candle, and 1.76 watts per candle at 85 volts, and 2.23 watts per candle, 1.66 watts per candle, and 1.03 watts per candle at 110 volts.

When the electrical pressure is unsteady the performance of both the metal-filament lamps mentioned herein is certainly most gratifying. The nearer the results obtained at varying voltage come to that secured at normal, the more the troubles will be diminished of the generating stations and of the persons using electricity for lighting purposes. With every recent development of a new lamp a marked improvement has taken place in this respect.

The substitution of metal-filament lamps for carbon-filament lamps of 16 or more candle-power should be given thorough consideration when a new lighting plant is being planned. There are many warrantable reasons for so doing, some of which have already been mentioned.

For isolated plant work with a given amount of illumination required, the size of the apparatus necessary for generating the electricity and the wire used for distributing it could be materially decreased. Thus a large saving on first cost would be made, as well as on interest of investment, depreciation, insurance, taxes and space occupied, which is sometimes of great importance. Naturally the consumption of coal, water, oil, etc., would be lessened. In many office buildings the peak on both the elevator and lighting loads comes between 4:30 and 5:30 in the afternoon, often continuing until 6 o'clock. Very little heat is required at that hour, and the exhaust steam, instead of being utilized, is practically wasted. Preparing for this sudden rise in lighting and motor load is also costly, and there is an extra loss after the peak drops back to normal, as this moment cannot be timed absolutely.

The lighting expense of hotels is to a certain extent the same as office buildings. The exhaust is used for heating and perhaps other purposes until about the time of heavy lamp load. This hour, which is 4 or 5 p. m. during the late fall, winter and early spring finds the hostelry comfortable, the radiators having done their work during the day. If the weather has been moderate, however, steam may have been kept out of the rooms until night. When such happens to have been the case, the heating load comes on rather heavily at 5 o'clock or so, and then gradually drops down. The lighting peak continues until 10 o'clock at least, as the lamps in a majority of the rooms will be burning, many not being lighted before 6:30. The office, parlors, dining and grille rooms, cafés, billiard parlor, barber shop, kitchen, etc., will be illuminated until long after any great amount of the exhaust steam can be utilized. A small percentage of it is used in keeping the temperature in the hotel at the proper point. Hot water, and, in some instances, laundry work, employs a portion of the exhaust at this period.

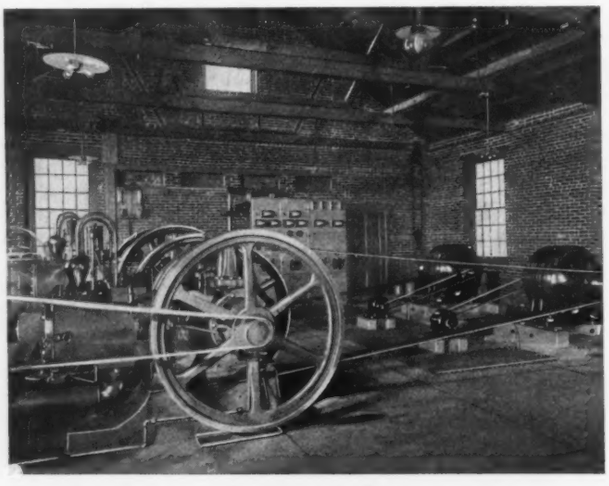
A central station already equipped and furnishing energy can add new customers through the medium of metal-filament lamps and if the latter lamps were also furnished to large peak load customers it would result in a reduction of the high points in the lighting curves.

Public lighting companies which now have the entire rating of their plants in service when the peak is reached, would by the adoption of tantalum and tungsten lamps in certain places be able to take on more customers without purchasing additional apparatus to care for this business. This refers particularly to companies selling electricity for lighting which find that by accepting more accounts they would not only add to their day load, which would be most profitable, but would also increase the peak to such an extent that their present equipment could not handle it.

Municipal Lighting Plant at Pennsburg, Pa.

A small municipal lighting plant of exceptionally efficient design has been placed in operation recently in the borough of Pennsburg, Pa., about 20 miles south of Allentown. This plant at present supplies street lighting for the borough and sells energy for residential and business lighting and small motor use within the borough limits. Although in operation barely three months, the connected load is 27 series arc lamps on street circuits and about 1300 incandescent lamps for interior illumination. This amounts to an average of over one lamp per inhabitant. The Perkiomen Seminary, situated about half a mile from the power house, will use about 15,000 kw-hours yearly. The hotels and stores of the town are also supplied with energy. It is estimated that the large number of summer visitors attracted by the natural charms of the region will so increase the summer consumption that in spite of the shorter hours, the load will equal if not exceed the winter demand.

A nominal rate of 10 cents per kw-hour has been fixed in combination with a schedule of discounts, which brings the rate down to 8 cents per kw-hour for large consumers. All



MUNICIPAL LIGHTING PLANT AT PENNSBURG, PA.

energy is sold by meter, with free lamp renewals. Present indications are that during the year 1908 the plant will pay all running expenses, interest on investment, depreciation and repairs, and such a profit that the borough will secure its street lighting at a net cost of approximately $15 per year for each arc lamp. The equipment installed is sufficient to supply twice the number of incandescent lamps connected at present; and the already excellent financial showing should be greatly improved as the number of customers increases. The management of the plant has been placed in the hands of a small, non-political, semi-permanent commission, whereby it is hoped to avoid the mismanagement so often existing in municipally-operated enterprises.

The power house is situated close to the tracks of the Perkiomen Railroad, a branch of the Philadelphia & Reading, and a siding for the delivery of fuel is provided. The building is 35 ft. wide and 45 ft. long, substantially constructed of brick, with stone foundation, slate-covered roof and concrete floor. The generating plant consists of two Crocker-Wheeler alternators, belt-driven by Mietz & Weiss oil engines.

Each alternator is rated at 35 kilo-volt amperes, 2300 volts, 60 cycles, at 1200 r. p. m. They are three-phase machines of the frame-bearing type recently introduced by the Crocker-Wheeler Company. The bearings are carried on three-arm frames supported from the frame of the machine, thus

obviating the necessity for a heavy base with pedestals for bearings. One collector ring is mounted on each side of the field element, which makes the machine very short and compact and reduces vibration to a minimum. Each generator has belted to it a Crocker-Wheeler 1.25-kw, 125-volt, 1570-r. p. m. exciter.

The engines are of the twin-cylinder, two-stroke cycle Mietz & Weiss type, using a low-priced fuel oil, and constitute a very economical source of power. The main bearings of the engine are ring-oiling, and force feed lubrication is used for all other parts. The engines are very easily started by the use of compressed air furnished by a small compressor belted to one of the engines in connection with a storage reservoir. The absence of electrical ignition and the general ease and simplicity of handling render expert help unnecessary and greatly reduces the running expenses of the plant.

Two 6000-gal. horizontal steel tanks are provided for the storage of fuel oil. They are located in the rear of the power house sufficiently below the level of the railroad siding so that the oil flows into them from the tank car by gravity, suitable piping being provided for the purpose. From the storage tanks the oil flows by gravity into a feed tank located under the power house floor, and is drawn thence by pumps with which each engine is provided.

The switchboard consists of two generator panels and one feeder panel, built by the Fort Wayne Electric Company. Each generator panel contains an exciter ammeter, a voltmeter, three generator ammeters, two field regulators, and a two-throw, three-pole oil switch. The feeder section of the board consists at present of one panel arranged for two single-phase, 2300-volt feeders controlled by two-throw oil switches. Two sets of bus-bars are provided and each generator and feeder may be thrown on either bus. All instruments are operated from transformers. The series arc system is regulated by means of a General Electric air-cooled, constant-current transformer, giving a secondary current of 6.6 amperes. The arc circuits are controlled on a small panel independent of the main switchboard. The arc lamps are 430-watt General Electric enclosed, and are hung from 10-ft. mast arms. The 2300-volt feeders are provided with lightning arresters, both inside the station and at various points on the poles. The customers' services are operated in groups from Fort Wayne transformers varying in rating from 600 watts to 10 kilowatts. The three-wire system is employed for all services in excess of 600 watts, and Westinghouse watt-hour meters are used throughout.

The Opportunities of the Small Central Station.

IT has been thought sometimes by owners of small electric generating stations that there have been no opportunities for such companies of which advantage has not been taken. It is true that there are a few small central station companies which have been remarkably active in taking advantage of their opportunities and in securing a high gross revenue per capita of population served, but in the case of the great majority of small central station companies, there are many neglected opportunities. Small central stations are probably not any worse underdeveloped than many of the large ones. The smaller companies have before them, however, more numerous practical examples of what can be done in the way of making the most of a plant than have the very large companies.

In a general way, it can be said that the prospects of the small central station company are to-day brighter than ever before. There are two reasons for this. One of them is a physical or engineering reason, and the other is the result of commercial development. The engineering reason is that in a great many instances the small, struggling plant can be economically supplied with energy over a transmission line from a generating station in some neighboring and larger town. Even if there is no large, neighboring town the consolidation of a number of stations in small towns, if supplied from one transmission network, is conducive to many economies in operation and management. In some other cases, energy can be purchased from electric interurban railway companies, and with proper automatic voltage regulating appliances, this energy can be used for electric lamps and motors in a small town.

The commercial reason why the chances for the small plant are better than ever, is that the every-day uses of electricity have been increasing and the number of men trained in the work of introducing central-station service more extensively into a community is daily increasing. There is thus a better chance to secure the necessary business management to make small central-station enterprises commercially successful.

PREPARATIONS FOR GROWTH.

As no two small plants are situated or equipped alike, no general statements can be made which will apply to the possible physical changes necessary in various stations to fit them for earning dividends. It is possible, however, to take up some of the conditions which are met most commonly in small American central stations. Considering each case by itself, the things required of the plant are that it shall be in a position to give 24-hour service and to supply any kind of industrial load available; to expand in size; to handle various loads without the operation of greatly underloaded engines, and to be provided with reserve machinery.

A condition frequently met with in small central stations is that 125-cycle distribution is used for incandescent lamp circuits and a direct-current series arc machine supplies energy for the arc lamps. There is little or no motor load and oftentimes no day service. The first thought should be to put the plant in shape to take care of motor load economically. It is possible to secure satisfactory single-phase, 125-cycle motors. It may be advisable if the field is exceedingly limited and there is no possibility that the plant will ever be connected up with a 60-cycle transmission system to retain the 125-cycle generators and have customers purchase 125-cycle motors. This policy is not to be recommended, however, except in some isolated cases. As a general rule, it will be better to change the system over to 60 cycles as rapidly as it can be done without too great a financial sacrifice. The 60-cycle system has the advantage that it can be operated with standard three-phase or single-phase generating apparatus, and should the opportunity come of purchasing energy in bulk or consolidating with other companies, the system under consideration will be in a position to make the change with little expense. Should the 125-cycle system be retained, in a growing plant it would mean simply putting off the change a few years, making it more expensive when it becomes necessary; or it would necessitate the use of belt-connected motor-generator sets for supplying the 125-cycle from the 60-cycle system. Another advantage of the 60-cycle system is that practically all the three-phase and two-phase generating apparatus now made is designed for 60 cycles or a lower frequency. Should the load grow to such an extent that large motors are called for and three-phase generators seem desirable for taking care of the motor load, the existing 60-cycle single-phase apparatus could be operated from these generators.

Assuming that it has been decided to change to 60 cycles from the higher frequency, the first apparatus to be looked after is the transformers. It is possible to operate old 125-cycle transformers on 60-cycle circuits, provided the transformers are not fully loaded. When fully loaded, they are likely to overheat. As a matter of fact, many companies operating 125-cycle systems now have their circuits fairly well loaded with 60-cycle transformers, as practically all modern transformers are built for the lower frequency. As far as the transformers are concerned, the change to 60 cycles comes in the natural development of the plant. The old 125-cycle transformers can be used underloaded and additional 60-cycle transformers purchased. If the generating plant is to be shut down and the supply is to be obtained from a 60-cycle transmission line, the question of changing the generating plant is not troublesome. If the generating equipment is to be changed from 125 to 60 cycles, there is a more serious financial proposition for a small

station, as it practically means the purchasing of new generators and getting nothing but scrap value for the old ones. Very often the plant is in a position to require extra apparatus anyway, so that the purchase of 60-cycle generators with an output to take care of both the new and the old load involves but little more than the original cost of the existing high-frequency generators. Most high-frequency alternators have been in use from 15 to 20 years, and are so approaching the end of legitimate life. It may be said that there are some small companies which cannot afford to make even this change. That is, they are operating in towns of 1000 to 1500 inhabitants, where the only load available is a lighting load. This is true of many towns in the West where there is little or no manufacturing. About the only hope for plants in such small towns is to consolidate them with others in order to make it possible to supply energy economically.

As to the direct-current arc dynamo in the 125-cycle plant, there are a number of needs to be considered before changes are made. A few years ago, if the incandescent lighting system was to be changed to 60-cycles, the natural course would have been to change the street arc lighting system to a 60-cycle, constant-current system supplying enclosed carbon arc lamps from tub transformers. Just at present it might be advisable to change the street lighting system to one using series tungsten incandescent lamps or to await the development of a luminous arc system suitable for 60-cycle alternating current. With either of these changes made, the station can be put in a position to generate its entire output in 60-cycle current or to take its entire supply from a 60-cycle transmission line.

Probably one of the most difficult situations to handle economically is found in the large number of small central stations which have 125-cycle, single-phase lighting circuits, direct-current motor circuits of 500 or 220 volts and possibly also, as a further complication, a direct-current series arc lamp system. Where such a separate motor and lighting distribution system exists, there is, of course, considerable industrial business for which customers have already installed direct-current motors. In such towns a change to a 60-cycle single-phase or three-phase system involves not only the lighting, but the motor distribution systems. Customers' direct-current motors would have to be displaced by either single or three-phase alternating current motors. If single-phase motors are used, their cost will be much greater than direct-current motors of the same output. To supplant the customers' motors at the lighting company's expense would, therefore, be a great financial burden in addition to the cost of changing the generating equipment. It has been done in numerous cases and somtimes may be justified, especially if the generating plant is to be abandoned and energy is to be supplied from a sub-station connected to a high-tension transmission system. In the latter case, a continuance of direct-current motor circuits would necessitate rotary converters or motor-generators in the sub-station, whereas if an alternating-current distributing system were used for all purposes, there need be no rotating machinery in the sub-station. In the latter case the sub-station could be left without attendants certain portions of the day. This depends very much on the size of the town. A sub-station which supplies energy to a village needs little attention save replacing fuses, and a blown fuse is a rare occurrence in such small places. The voltage regulation of such a sub-station is taken care of at the main generating station. Considering the infrequency of short circuits, it is usually justifiable in villages to depend on a trouble man located somewhere in the village to replace fuses and clear up line troubles in emergencies, and it is not necessary that he be in constant attendance at the sub-station. This question of the necessity or the absence of necessity for a constant sub-station attention has a vital bearing on the future policy of a company about to take hold of a plant of the kind under consideration where there are direct-current motor circuits and alternating-current lighting circuits. No general rule can be laid down as to what the policy should be, because in some cases the cost of replacing a few customers' motors with 60-cycle alternating-current motors would not justify the expense of putting in a motor-generator or rotary converer to supply the direct-current circuits for a number of years and maintain an attendant at the sub-station constantly. When, however, the supply is to be continued from a generator plant rather than from a sub-station, the best course to pursue may be altogether different, because it is necessary to keep men at the generating station constantly in any event. The maintenance of two separate sets of dynamos may be an inconvenience and add somewhat to the operating and maintenance expense, but in many cases its cost is not enough to justify a wholesale change. The course usually followed by many of the larger companies in a case of this kind is to install 60-cycle lighting equipment as rapidly as possible, and whenever a new motor load is secured to feed it from the 60-cycle service. This will usually enable a small station to obtain a motor load some distance from the plant, which it was not able to get before. In the meantime, the direct-current motor load is not allowed to grow, no new customers being taken on direct-current service. Customers with motors that are nearly worn out are persuaded to buy new alternating-current motors. As the alternating-current load gradually increases and the direct-current load decreases, it may be advisable to install a motor-generator or rotary converter set to supply the direct-current circuits during hours when it would not be economical to run an engine driving a direct current generator. This, of course, depends on the units that are in the plant. In small stations with mixed service, there is usually a small direct-current generator which can be belted to the smallest engine for use during light load. It is only when the station reaches such a size that large alternating-current generators with economical engines are in use that the motor-generator proposition is worth consideration.

A small proportion of the small electric-light stations of the country have direct-current, 110-volt systems. Where the stations are in very small towns and have been giving night service only, there is no motor load to consider. It is sometimes advisable to connect the station up with some neighboring town by means of a transmission line, and it is a simple matter to change from 110-volt direct-current service to 110-volt alternating-current service. Very often by some inexpensive changes, a system can be changed from 110-volt two-wire to three-wire, the whole town receiving energy from a central transformer. If the town covers considerable area, however, it might pay to take down a large part of the feed wire installed for the direct-current system and put in an alternating-current distribution system with 2000-volt primaries, retaining a part of the old feeders for 110-volt secondaries.

There are a number of 220-volt, two-wire central stations throughout the country. These present a situation just the reverse of that found in the stations having nothing but 125-cycle alternating-current distribution. The 220-volt, direct-current, two-wire system, while it is well adapted to the motor load in a very small town, is not well suited for lighting circuits. Its unsuitability for the latter purpose is becoming daily more pronounced as the new higher efficiency incandescent lamps are brought out. These are not made for 220 volts. As far as lighting is concerned, the direct-current, 220-volt plant is tied down to very inefficient incandescent lamps and very inefficient, unsteady arc lamps. To be sure, the new incandescent lamps, like the tantalum and tungsten, can be operated two in series from 220-volt circuits, but this is a rather unsatisfactory makeshift. If a two-lamp series cluster is used, it frequently has the lamps pointed at such an angle that it makes it difficult to procure reflectors giving the desired distribution of light. On the other hand, if the wiring is to be changed so as to put two lamps in series, the arrangement can only be applied with economy to large lighting customers. It is practically unsuited to residences. Fortunately the way out of the difficulty which confronts 220-volt direct-current stations is in many cases very easy, provided there is no motor load. If the apparatus is to be continued in operation, a neutral feeder can be installed and customers' services can be changed from 220 to 110 volts. At the power house a small balancer set will serve to balance the system if the load is properly connected on the two sides. If the operation of the power house is to be dis-

continued and the system is to be changed to alternating current, the change would consist of the installation of a neutral wire and connection of the system to a three-wire transformer at the station or to transformers located in each block.

COMMERCIAL POSSIBILITIES.

The foregoing portion of this article has outlined some of the changes which must be made in various types of plants to enable them to economically take care of a greater output. Of course, in all cases of this kind, if the net earning capacity were not to be considerably improved no changes would be justified. The changes are not suggested because of any fancy engineering ideas, but simply to point out how central-station companies may expand with some assurances of success. In the case of very small plants, too much emphasis cannot be placed on the importance of consolidation of generating stations. The ELECTRICAL WORLD has from time to time published data on the cost of operating small central-station steam plants as compared with the cost of operating them in conjunction with some neighboring plant. In a general way it may be said that the load of a station operating in a rural community of about 1000 inhabitants can be carried by a plant operating in a town of 2000 to 4000 inhabitants at a reduction in regular operating expenses of at least 75 per cent of the cost of operating the smaller plant, and frequently more than this.

There is, of course, no object for a company to increase its investment in a central-station enterprise unless by so doing the percentage earned on the investment can be increased. It is not, therefore, simply a question of getting more business, but a question of getting business of a kind which will increase the kilowatt-hours sold per dollar invested. With a plant in operation 24 hours per day, any increase in output which does not require increase in generating equipment and consequent increase in investment is tolerably sure to increase the net earnings on the investment. The operating expenses for the larger output will not increase in the same proportion as the output; and even if they did increase in the same ratio, the percentage earned on the investment with a large output would be greater than with the small.

The central-station company should aim to be the sole energy producer for the community, except as regards intermittent work which is unprofitable because of the large investment involved in apparatus mostly idle. Looking over a small community for the opportunities for the sale of energy, the waterworks system if there is one, comes in for first consideration as a desirable load. Numerous small central-station companies have pumped water for the city at a profit both to the city and to the company. If a company is about to embark in 24-hour service where it has previously given only night service, the securing of a city water-pumping load is very important. Where there is a stand-pipe or provision for water storage in connection with the water works, this city pumping offers an ideal load for a central station, because it can be shut off during the principal lighting hours from 5 to 9 p. m. It is difficult to understand why more central-station companies do not get this business. In many cases cities have feared that the central station would not be sufficiently reliable, such fears having been justified by the irregular performance of the apparatus in years past and by its generally dilapidated and run-down condition. Until a company can inspire confidence in a community by its service and the general appearance of its property, it cannot expect to get such pumping contracts. In any event the existing steam plant of the waterworks can usually be kept as a reserve with fires ready to kindle and the electric pumps simply installed in addition to the steam pumps already in use. Centrifugal pumps are coming into favor for use in city water pumping of this kind. For deep-well pumping, where it is possible to remount the well to a diameter of about 14 ins., vertical-shaft deep-well centrifugal pumps can be obtained. Another method is to gear a motor to a properly counterbalanced deep-well plunger pump. If the water is raised from the well by compressed air instead of by deep-well pumps, the motor can, of course, be used to operate the air compressor.

In the average small town there are many more places requiring motors than the average man thinks of offhand. Besides the small factories, there are the blacksmith shops, machine and repair shops, printing offices, railroad water pumps, drug store carbonators and laundries to be found in nearly all towns of 1500 inhabitants and over. Besides this, there are frequently stone crushers and brickyards to supply. By judicious soliciting on the part of the manager, two or three refrigerating machines ought to be equipped electrically in every town of over 4000 inhabitants. The use of electric fans can be greatly increased by getting after this business.

The fan is useful both in summer and in winter. With its uses in summer all are familiar. Its winter uses are not so well known. It is proving especially valuable to increase the air circulation in hot-air appliances, as described a number of times in these columns. When so installed, it will be used every morning in cold weather to hasten the heating of the house, as it is possible with forced circulation to heat the house in the morning in about half the time that is usually required to raise the temperature to a comfortable point and to reduce the length of time which the furnace must be run at maximum heat, thus saving fuel. For drying clothes in laundries, for hairdrying in barber shops and elsewhere, the fan has so far been little used, but should find wide application in the future.

A number of small central stations have met with remarkable success in the introduction of motors of about one-quarter or one-eighth horse-power for general household purposes such as driving a washing machine, meat grinder, coffee grinder and polishing wheels. For such use, the motor is usually belted to a short length of line shaft from which any of these appliances can be driven.

In the average small town only a small percentage of the residences which should use electricity are connected to the company's lines. This is another chance for increasing load of the right kind. It should be noted that everything mentioned so far as is in the direction of increased revenue without requiring increased station equipment in proportion. Along with residence lighting comes the use of the electric flatiron and various light cooking appliances, with occasional complete ranges, all of which add to the profitable nature of a company's load.

In towns where there is no waterworks service, many of the owners of the larger residences may be induced to put in electric pumping outfits and in this way the absence of a waterworks pumping load can to some extent be counteracted.

In most small towns show-window lighting has not been developed to any extent. This is a class of lighting which a central station can always encourage to its profit.

Mention so far has only been made of some of the principal classes of business which can and have been developed by a number of small companies and which ought to be developed by many more. In general, it may be said that no company has worked up its business to anywhere near its possibilities until its earnings reached $6 per annum per capita of population served. How much more than this can reasonably be expected as an average, only the present great activity in getting central-station business can prove. Over $8 per capita has been reached in some cases so far. It is not possible in an article of this kind to go into the details of how these various classes of business are obtained. Thoroughly reliable service, at rates which encourage the use of energy at other than peak load periods, are fundamental requirements. Persistent solicitation is necessary. One peculiarity of the electric lighting business is that the class of business which grows most rapidly and with the least effort is that which is least desirable for the company; namely, the lighting load which is on only a short time each day. Such business as it grows calls for an increased station equipment. If a small station is working very much under its rated output this business is temporarily desirable. If the apparatus is working up near its rating, so that an increase in peak load means an increase in investment, it is still valuable because this increased load can be usually taken care of without a proportionate increase in investment and operating expenses, but it is not as desirable as many other classes of business calling for less investment in proportion to the revenue they yield.

The Central Station Situation in New England.

THE outlook of the New England central-station industry for 1908 is bright, with the prospect of continued progress in both the business and technical administrations of electric lighting and power properties. Evidences are not lacking of a closer cooperation between the companies and the public which they serve, and the engineering side of the central station practice constantly tends towards better methods of operation, more permanent forms of construction and more far-sighted analyses of future needs. Investigation of the hazards of municipal ownership has several times resulted in the dismissal of the problem, at least for the time being, on the part of municipal governmental committees and boards; and it is now squarely up to the companies to increase public confidence in their work to the point that shall make private ownership and operation under the broad regulative control of public commissions universally preferable to municipal administration and ownership.

There is no question that the aggressive new business campaigns which many of the companies in New England have carried on within the past two or three years are indirectly responsible for a growing sentiment of fair appreciation of the central station business by the general public. In some centers socialistic agitation no doubt tends to increase, but on the whole, the central station policy of meeting the public face to face in the exhibition department, or vigorously seeking new business which shall be mutually profitable to the public and the companies, of frankly answering reasonable inquiries as to commercial methods and limitations, has gone far to disarm hostility and to bring the consumer to the point of active friendliness. It is clear that these aspects of the exhibition and convassing phases of the business have worked untold good in the matter of public relations, and great credit is due to the companies which early saw the wisdom of spending money to bring themselves into direct and vital touch with the public. The policy of having nothing to conceal reaps a rich reward in these days of publicity and investigation.

The maintenance of a dignified, conciliatory attitude in which the desire of a company to meet an inquiry squarely and clearly, and even to go to large expense to satisfy the public that sound and equitable methods are its practice, always tends towards the preservation and increase of mutual friendliness. Perhaps the best illustration of this during the past year in New England was in connection with the rate inquiry of the Boston Public Franchise League in relation to the charges of the Edison Electric Illuminating Company of that city Through the investigation, lasting many months, and which at this writing remains to be adjudicated, the company spared no pains to get at the actual facts bearing upon its cost of production, although many of the inquiries were couched in indefinite phraseology, uncertain in their meaning and at times exasperatingly insinuating in their suggestions of deliberate unfairness. Expert advice was secured, unusual cost analyses made, and in particular the demand system of charging was explained with reasons for its use in a pamphlet generally distributed to all interested parties at the company's expense. Questions that were of uncertain interest were re-stated by the company as it understood their general sense, rather than answered literally, and at all times in the investigation the company favored the holding of conferences with the petitioners. Whatever may be the decision of the Gas and Electric Light Commission regarding the existing rates of the Boston Edison Company, it is significant that but a mere handful of its customers out of thousands of consumers in its 400 square miles of territory in and around Boston appeared in opposition at the hearings, and there is no question that the company's tolerant and frank policy of open handed co-operation served it well in the metropolitan territory which it supplies. Co-operation is the secret of a successful central station policy, and in New England there is a growing sense of this in every branch of the industry.

In the matter of new business getting, the companies whose agents have shown prospective customers that they can actually save money by the installation of electric motors are the ones which are making the most rapid strides in increased connected load which stays connected and satisfied. The rate problem is really one of secondary importance if the customer can be shown positive economy by the use of electricity. There is no question that the skill required to work out such economies in the face of inadequate methods of previous cost-keeping is of a high order. In the granite industry at Barre, Vt., for example, the stone quarries and cutting sheds often had no accurate idea of their steam power costs prior to the introduction of electricity by the local central station. It was a hard problem to show companies of this kind economy in monthly power bills of two or three hundred dollars when they were formerly accustomed to paying for fuel, repairs, supplies, wages, taxes and replacements in smaller sums at irregular times. The question had to be solved along just these lines, however, and the successful extension of the connected load has rested directly upon the company's ability to figure these elusive costs in relentless detail.

The novelty of the exhibition room plan has undoubtedly worn off now, from the standpoint of the central-station manager. Some of the apparatus exhibits now made at the offices of certain companies look a little the worse for wear, and the early enthusiasm shows signs of lagging in some places. Obviously no company can expect to display each week a bewildering succession of novelties and new inventions, and keep it up indefinitely. Observation shows, however, that it pays to keep every exhibition of apparatus clean and in working order, and an occasional change in window setting is possible even with the same equipment. The passing of the seasons affords an excellent opportunity to call special attention to some one or two articles, and to leave the others for more timely occasions. The electric flatiron, for example, is a strong summer topic, as is the fan motor, while the electric chafing dish, the bathroom heater and other equipment are peculiarly adaptable to winter conditions. While no hard and fast line can be drawn between the seasonal and the perennial apparatus, variety can be secured by paying some attention to the time of year; and as increasing use of appliances, motors and lamps creates new data, it ought not to be difficult to show the standard products in new lights. It is a positive injury to the good name of electrical appliances to allow exhibits to get into slack condition. Fortunately most of the New England companies appear to observe that cleanliness and trimness in their exhibition quarters which is so conspicuous a feature of domestic life in that section of the country.

Direct personal solicitation of new business appears to have largely taken the place of extensive mail advertising campaigns in New England central station work. In the small community, and even in the city of 50,000 to 100,000 population, the local company manager has so extensive an acquaintance, as a rule, that the personal touch is worth far more than the letter advertisement. In the larger cities the companies specialize more with respect to the soliciting of lighting and power contracts, and the solicitor simply carries the personal element into the field where he works, subdividing the duties of the new business man in the smaller town. There is a tendency in the smaller communities for the local public to view any extensive systematic mail campaign as extravagance on the part of the company, whereas judicious newspaper advertising, even in the small town, is never regarded as an undue expense. Circumstances arise where follow-up letters produce good results, but in the small community the distances are short, time is taken more leisurely than in the great cities, and the personal visit is the natural custom which produces the best results. Somewhat the same conditions apply to the use of electric signs by operating companies. The larger the city, the more it pays to spend on effective sign practice, but even in the small town one or two attractive illuminated signs in the vicinity of the company's office are undoubtedly worth while.

Free renewals of 3.5-watt incandescent lamps are given

throughout New England generally, but there is considerable difference of opinion as to the wisdom of renewing the high-efficiency lamps free of charge. Most of the companies in New England appear to realize that the public demand for high-economy lamps is bound to be satisfied, and that now is the time to prepare for more extended uses of electricity on the basis of low watt consumption for a given illumination. The advent of a 20-cp lamp consuming about 25 watts, would, in commercial quantities, stimulate the lighting business in the East wonderfully in competition with gas. There is no denying that gas, and even kerosene, have a pretty strong hold in New England households, but when the community is fortunate enough to obtain energy from water power, the question of gas competition is relatively much less important. With coal as the basis of energy generation, and high-economy lamps in small sizes available for general use, the gas company will find it hard to compete in illumination with the central station, even with gas at $1 to 85 cents per 1000 cu. ft. The value of electricity on the score of greater cleanliness and no vitiation of the atmosphere, is, perhaps, as generally appreciated in New England as in the West; but the central station is sure, ere many years pass, to feel the benefits of the fresh air campaign indirectly in the increased demand for electric lighting in old residences and buildings. The flaming arc is rapidly coming into use in New England, chiefly in connection with entrance lighting of hotels, theatres and large stores; the mercury vapor lamp is in use to some degree in the power house, notably at the New Haven's Cos Cob station, and in the shop department, conspicuous, for example, in the Graton & Knight tannery installation in Worcester. The Nernst lamp has been installed to a large extent in New England, and with most satisfactory results to both central station and consumer.

The central-station motor business in New England seems to be in a remarkably healthy condition, judging by the increasing connected loads evident in the different states. During the year between the last two reports of the Massachusetts Gas and Electric Light Commission, Attleboro increased its motor-connected load from 848 to 947 horse-power; Cambridge, from 1640 to 2327 horse-power; Boston Edison, 26,416 to 30,431 horse-power; Fitchburg, 948 to 1447; Lynn, 1479 to 2266, and Salem, 670 to 850. Gratifying growth in the use of motors is also a feature of recent central-station work at Bangor, Lewiston, Auburn and Portland, Manchester and Franklin, N. H., Montpelier, Rutland, Burlington, Providence, Hartford and New Haven. The special applications of motors in New England are very largely in connection with manufacturing industries, and in some companies an electric railway load is an important feature of the motor business. The amount of steam power in small units used in New England, however, is so large, and so much of it is used inefficiently, that there is no question that a very attractive field for central-station motor service exists here. In one of the chief manufacturing cities of the New England territory the motor-connected load increased last year but 1 per cent, and there is no question that this particular central station might increase its motor load several times over with energetic cultivation of the new business field. In the New England climate a large amount of the exhaust steam is used for heating during the months from November to May, but the scattered installations of motors are attractive problems for attack on the commercial side. It is interesting to note that the motor load in some of the New England cities is greatly in excess of the lighting maximum, even during the winter months. The outlook in the motor field is unquestionably promising at this time, but it is a serious problem whether the rates charged by some of the companies are not too low, considering the increased cost of operation which public service corporations are facing all along the line.

No general discussion of the rates can be of much value to specific central station conditions, but it is worth the while of every manager who is selling energy at rates of 2 or 3 cents per hp-hour to investigate the actual cost of producing that energy, allowing as far as possible for fixed charges and administrative expenses. The cost of generation is one matter and the cost of distribution another, sometimes adding 50 per cent to the former. More definite knowledge of all the costs is highly desirable at the present time.

In physical equipments, the New England central stations are making progress, largely in the direction of enlarging the capacity of established plants with improved machinery. Worcester is installing a turbo-alternator equipment which will supersede belt-driven alternators and Brush arc machines driven from line shafting, and all the street arcs in that city are now magnetites. About 800 of these lamps are in service, with mercury-vapor converters at the station supplying direct current to the lamps at 4 amperes and from 300 to 320 watts at the lamp terminals. Fall River is also committed to the magnetite system in its street service. A new central station is practically completed at Fall River, and the new plants at Lowell and Portland are also notable additions to the modern equipment of the New England stations. Pittsfield is getting some good records in generating economy from a Diesel oil engine plant. In the hydro-electric plants of Maine, New Hampshire and Vermont, expansion of facilities is constantly necessary to meet the demands of the motor market. The single-phase motor is coming more generally into service, and it is safe to state that the suburban power problem is no longer unsolved, with this type of motor available for service at the ends of long feeders.

The tendency of generating plants to consolidate their services into 2300-volt energy supply for all their distributing lines continues to act as a standardizing force in power station design. The steam turbine has grown in favor in many of the latest installations of New England, though the reciprocating engine is far from driven from the field in established plants. In the design of a new lighting plant for steam generation, however, in New England, the use of reciprocating engines instead of turbines would be something of a surprise.

Recent changes in ownership among the New England central stations have been mainly along the lines of securing properties with the idea of improving their physical and commercial conditions to the end of bettering the earnings and profits of the companies. Among these are several suburban extensions of the Boston Edison teritory, the purchase of the Leicester, Mass., system by the Worcester Electric Light Company, the centralization of control by E. W. Clark & Company, of Philadelphia, of the Bar Harbor and Union River Power Company and the Bangor Railway & Electric Company; the sale of the Amesbury Electric Light Company to the banking house of Geo. A. Fernold & Company, of Boston; the control of the Dover and Brattleboro companies by A. H. Bickmore & Company, of New York; the sale of the Andover Electric Light Company to the Lawrence Gas Company; the change of management of the Woonsocket and Pawtucket companies to the supervision of the Stone & Webster interests; and the transfer of the Portland interests to the Seligman banking house, of New York. The Ayer, Mass., company is now controlled by the Massachusetts Lighting Companies, of Boston. Practically all the commercially successful central stations of New England are now receiving careful and progressive management, and the interest displayed in the scientific administration of these properties is a certain indication of substantial progress to be expected in the coming year.

Special Lighting for Chicago Streets.

The Commonwealth Edison Company, of Chicago, has recently closed contracts whereby certain portions of Halsted and Twelfth Streets will be brilliantly illuminated. These are not down-town streets, but are important business streets on the west side, about two miles from the business district. On Halsted Street, from Taylor to Fourteenth Street, a distance of 2200 ft., this special lighting will be installed, and also from Halsted to Jefferson Street on Twelfth Street, a distance of 1400 ft. The plan is to place 300-watt enclosed carbon arc lamps operating on 110-volt, constant-potential, direct-current circuits

with posts about 50 ft. apart. This matter has been handled by making contracts with individual owners at $1.35 per week per post on a two-year basis. The lamps are controlled by the company, and are to be used from dusk until 10 p. m., five nights in a week, and until midnight one night per week. The design of post to be used is shown in the accompanying engraving. The lamp globe is 10 ft. 6 ins. above the ground. On North Avenue, one of Chicago's outlying business streets on the north side, about two miles from the down-town district, special spectacular lighting has been employed on several occasions. In this case incandescent lamps are hung from the side of the street to a wire placed high above the center of the street.

Recent Power Developments at Montpelier.

DURING the past few years a number of comprehensive power improvements have been under way at Montpelier, Vt., with reference to the supply of electricity in a growing territory of about 27,000 population. About six miles south of Montpelier lies the thriving city of Barre, which is the immediate center of the Vermont granite industry, and which is a large consumer of energy for lamps and motors. Montpelier, the capital of the state, is a noted business and residential center, famous as the birthplace of distinguished men, and one of the most substantial and conservative communities in New England. The supply of electricity throughout this territory is now in the hands of two companies under common management, the Consolidated Lighting Company, and the Vermont Power & Lighting Company. Messrs. Sanderson & Porter, of New York, are the consulting and constructing engineers of the companies.

The Consolidated Company has been in operation since 1885, and the Vermont Power & Lighting Company since the spring of 1907. The latter organization is the successor of the J. S. Viles Electric Light Company, and has been leased to the Consolidated Company for a term of 25 years. The officers of the Consolidated are: President, Jas. E. Davidson; vice-president, J. C. Tomlinson; treasurer, A. D. Bennett; secretary, C. S. Davidson, and superintendent, E. O. Wedge. Mr. Geo. G. Moore is president of the Vermont company, the vice-president, treasurer and superintendent being those of the Consolidated, with Mr. J. E. Davidson as secretary and general manager.

At the present time the generating plants of the companies are operated separately, but the systems are temporarily provided with a tie line on their low-tension sides, so that one can help the other in case of emergency. The transformers of the old Viles plant were wound for 15,000 volts on the line side, while those of the Consolidated system are wound for 12,000 volts. It has not been found feasible to operate these two outfits together, but it is probable that changes will sooner or later be made with the object of more closely harmonizing the operation of the generating stations. The Viles plant is not of the same modern degree of construction as the plants of the Consolidated company, and until this station is either rebuilt or superseded by a new plant on the same general site, it is a question just how much would be gained by a radical change in operating policy.

In the accompanying illustration (Fig. 1) a sketch is shown of the high-tension systems of the two companies, not drawn to scale, however. The Consolidated company operates a hydro-electric station at Bolton Falls, 18 miles down the Winooski River below Montpelier, and a reserve steam plant in the outskirts or "Pioneer" section of Montpelier. Sub-stations are located in Waterbury, Montpelier, Barre and Graniteville. From Bolton Falls to Montpelier 3 three-phase circuits of bare copper are run, the sizes of two circuits being No. 4 and the third No. 1. From Montpelier to Barre, 6 miles, a single three-phase No. 1 line is run, and from Montpelier to Graniteville, 9 miles, a No. 4 line is carried. At Graniteville are centered some 39 granite quarries, the stone sheds where the monument production takes place being mainly in Barre. The Consolidated company also serves East Barre, South Barre and Williamstown. The Vermont company has a single water-power generating plant at Middlesex, 6 miles north of Montpelier. This supplies energy to a sub-station in Montpelier by a No. 4 line, and one in Barre by a No. 1 line about 12 miles long. About 200 stone-cutting firms are in business in the vicinity of Barre, with a payroll of $285,000 per month. The power market in Barre and Graniteville calls for upwards of 5000 horse-power, with a possible maximum development of 10,000 horse-power. Independent steam plants with coal costing about $6 a ton are here displaced with electricity selling at from 4 to 2 cents per kw-hour. The total connected power load of the two companies aggregates 3300 horse-power, making 8.2 inhabitants per horse-power in the territory—an unusually high development. The growth of the Consolidated company's power business has been over 200 per cent since May 1, 1905. At that time the connected load was 758 horse-power, and it is now 2500. The company has about 800 electric flat-irons in service and six complete electric kitchens. Last winter it moved

CHICAGO LAMP POST.

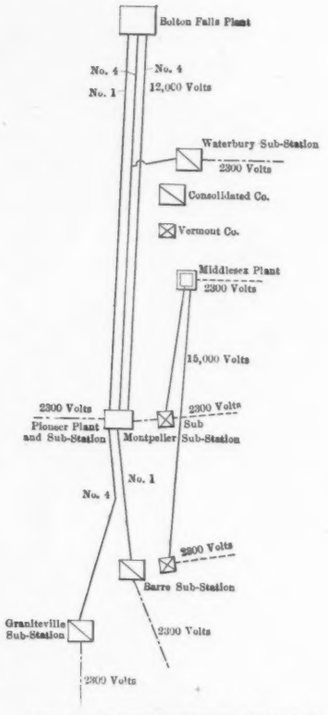


FIG. I.—SYSTEM OF THE CONSOLIDATED LIGHTING COMPANY.

into a new office on the street level at 20 Langdon Street, near the center of the business district of Montpelier. The old office was unfavorably located with respect to the exhibition of heating appliances, cooking and sign equipment, small motors and lighting appurtenances, but the new headquarters is thoroughly modern in this respect.

The Consolidated company has about 1321 lighting customers and a connected lighting load of 25,987 16-cp lamp equipments. The motor load is distributed among 96 motors. The maximum capacity of the Bolton Falls plant is 2300 kilowatts, and of the Pioneer steam plant 2200 kilowatts, making a total of 4500 kilowatts. The Vermont company's Middlesex plant has a maximum capacity of 1200 kilowatts, serving about 1000 lighting customers and supplying 1100 horse-power connected load.

Power is used in the quarries for the driving of air compressors, drills, operation of derricks and hoists, and the haulage of grout cars. The largest single installation in a quarry is at Websterville, in the establishment of Wetmore & Morse. This outfit uses six motors aggregating 274 horse-power, consisting of a 150-hp, three-phase, 440-volt induction motor driving a horizontal air compressor; a 55-hp hoist; a 30-hp hoist;

a 20-hp grout car motor; a 15-hp swing derrick motor and a 4-hp derrick motor.

In the stone sheds the power requirements include the driving of a considerable variety of special machinery used in the manufacture of monuments and mausoleums. The most representative installation of this kind is at the sheds of Barclay Brothers, Barre. The following data of a test made this fall upon the motors in this installation illustrates the variety of machinery driven and the power demands of the work:

MOTOR TEST, BARCLAY BROS. GRANITE SHED, BARRE, VT.

BLACKSMITH SHOP

Five-hp, 220-volt, 1200 r.p.m. induction motor, driving 4 grindstones, 4 to 5 ft. in diameter, and 5-in. face, and one 15-in. fan supplying air for 8 forges.

All running free	Four men grinding tools
Volts 223	Volts 226
Amps. 7	Amps. 7.9
KW 1.38	KW 1.78

TURNING DOWN ONE STONE

Average power	Maximum power
Volts 229	Volts 221
Amps. 9.67	Amps. 14.2
KW 2.62	KW 4.55

During test none of the forges was in use.

CUTTING LATHES

7.5-hp, 220-volt, 1200 r.p.m. induction motor, driving 2 cutting lathes, 1 grindstone and 24 ft. of shafting.

ONE LATHE RUNNING WITH STONE COLUMN 22 IN. DIAMETER

Roughing	Smooth cut ½ in. deep
Volts 216	Volts 229
Amps. 14.3	Amps. 14.85
KW 3.47	KW 3.97

BOTH LATHES RUNNING

No. 1, cutting 22-in. column; No. 2, roughing stone 16-in. diameter. Volts, 221; amps, 16.75; kw, 4.96.

SHAFT LOAD, INCLUDING GRINDSTONE

Volts, 234; amps, 11.28; kw, 2.03 (grindstone running).

CRANES

20-hp, 220-volt, 1200 r.p.m. induction motor, driving 50 ft. of shafting, and two 1000-ft. ropes from which are driven two traveling cranes. The ropes can be slipped off the shafting by means of loose pulleys.

SHAFTING LOAD

Volts, 223; amps, 23.5; kw, 3.97.

Shipping on 1st rope	Shipping on 2d rope
Volts 205	Volts 205
Amps. 80	Amps. 115
KW 25.45	KW 37.5

BOTH CRANES IDLE, ROPES RUNNING

Volts, 215; amps, 56.5; kw, 18.1.

ONE CRANE AT WORK—12-TON LOAD

Hoisting	Traveling
Volts 212	Volts 208
Amps. 91.8	Amps. 92.2
KW 29.8	KW 29.8

Average load for several hours was about 21 kw.

SHARPENING MACHINE

5-hp, 220-volt, 1200 r.p.m. induction motor, driving trip hammer, bucket chain, plate chain, brine pump and two small emery wheels.

ALL RUNNING EXCEPT HAMMER

Volts, 221; amps, 6.73; kw, 1.56.

ALL RUNNING

Average power	Maximum power
Volts 221	Volts 222
Amps. 10.65	Amps. 12.42
KW 3.35	KW 3.98

POLISHING MACHINES

15-hp, 220-volt, 1200 r.p.m. induction motor driving 40 ft. of shafting and 3 polishing machines. All three machines buffing; two with 20-in. wheels, one with 6-in. wheel.

ONE LATHE, 20-IN. WHEEL

Volts, 241; amps., 21.25; kw, 5.64.

TWO MACHINES RUNNING, 20-IN. AND 6-IN. WHEELS

Volts, 241; amps., 22; kw, 6.32.

THREE MACHINES RUNNING

Average power	Maximum power	Shafting load
Volts 231	Volts 236	Volts 236
Amps. 29.6	Amps. 33.2	Amps. 19
KW 10.16	KW 11.48	KW 66

BLOWER

5-hp, 1200 r.p.m., 220-volt, induction motor driving 7a-in. blower. Pulley ratio, 3.75 to 1. Average power, volts, 221; amps., 32; kw, 10.8.

GANG SAW

20-hp, 1200 r.p.m., 220-volt, induction motor driving 1 gang saw, 1 polishing machine and 70 ft. of shafting. Gang saw making 5 cuts through a stone 8.5 ft. long and polishing machine was buffing with 20-in. wheel.

SAW ALONE RUNNING

Volts, 260; amps, 43.9; kw, 16.78.

SAW AND POLISHING MACHINE RUNNING

Average power	Maximum power	Shafting load
Volts 236	Volts 262	Volts 260
Amps. 54.9	Amps. 59.3	Amps. 25
KW 21.6	KW 23.95	KW 4.9

60-LB. AIR COMPRESSOR (Drives 40 pneumatic tools)

35-hp, 900 r.p.m., 220-volt induction motor driving a 12-in. by 14-in. air compressor, double-acting, 60-lb. pressure, 141 r.p.m.

Intake closed	Full load
Volts 225	Volts 225
Amps. 62.2	Amps. 85.9
KW 20.2	KW 27.5

90-LB. AIR COMPRESSOR

50-hp, 900 r.p.m., 220-volt induction motor driving one 90-lb. compressor, 12 in. by 14 in., double-acting, 143 r.p.m.

Intake closed	Full load
Volts 208	Volts 223
Amps. 59.5	Amps. 118
KW 15.2	KW 39.3

This compressor is used with two surfacers, two plug drills and one pneumatic polishing machine. Motor ran 66 per cent of the time fully loaded.

POLISHING LATHES

10-hp, 1200 r.p.m., 220-volt induction motor driving one double-header polishing lathe, one single-header polishing lathe, one 12-in. buzz saw and 60 ft. of shafting.

DOUBLE-HEADER RUNNING WITH 22-IN. COLUMN OF STONE

Volts, 226; amps., 17.64; kw, 5.63.

Shafting load
Volts 224
Amps. 10.7
KW 4.6

DOUBLE-HEADER AND SAW RUNNING; SAW NOT IN USE

Volts, 226; amps., 19; kw, 6.35.

During the month of August the total power consumption of this shed was 15,020 kw-hours. The blower motor was a temporary installation, to be replaced by a larger one.

The above installation is supplied with power through three 40-kw, 1200 to 220-volt transformers.

The Bolton Falls plant is located in a rocky gorge of the Winooski River in the heart of the Green Mountain range and near Camel's Hump Mountain. The river is dammed at this point and below the dam it widens into a broad channel. The original development was about nine years ago, in the shape of a timber cribbed dam 48 ft. high, with stone filling. This was reconstructed a few years ago by building a coffer dam across the river about on a line with the draft tubes of the water-wheels in the power station. The water was pumped out and all loose material removed to the ledge. Channels were cut to prevent sliding on the bottom and shore ends, and a masonry dam was constructed below and against the timber work, bonding the masonry into the cribbing. In this reconstruction of the dam no apron could be used without closing the tail race. As a result, the water had a sheer fall of 50 ft. into the channel forming the tail race. The stone dam was not designed to withstand a static pressure of 50 ft. head, but was built with openings to relieve it. The up-stream slope of the dam was reinforced in the second construction by additional planking

The present development, which is illustrated in the accompanying drawing, consists of a solid masonry dam 60 ft. high and 200 ft. wide, with a capacity of 3000 horse-power. The drainage area is well timbered, with much swamp and pond surface, tending to equalize and improve the flow of the river. The Consolidated Company owns the water rights in perpetuity. The first installation required a power house 135 ft. long by 25 ft. wide, with masonry foundations, brick walls, and a timber-trussed and sheeted roof. There were two 450 kilowatt units in this layout. Water was supplied to the wheels by a penstock passing from a forebay through a masonry bulkhead wall, the gates and rocks being located on the river side of the forebay. Two pairs of 27-in. Hercules wheels were installed, each pair being direct-connected to a 450-kw, 12,000-volt, three-phase, 60-cycle General Electric revolving-field alternator, making 360 r. p. m. normal speed. Two Lombard governors and two exciters were provided. The latter machines consist of a 25-kw belted unit and a 20-kw, direct-connected, 125-volt outfit. The switchboard for these two machines contained five panels, two for each generator, two line service panels and one exciter panel. The station building was located below and at right angles to the bulkhead wall. The draft tubes of the first two sets of wheels pass diagonally through the foundation walls of the building into the tail race pits, which are excavated out of the solid rock, and are just below the overfall of the dam.

Increased capacity was evidently essential at this plant in

1906, and a careful study of the flowage of the river was made to determine the capacity which could be secured. It was assumed that the daily flowage for 1904 was a fair average of

FIG. 2.—11-FT. PENSTOCK.

the hydraulic conditions. It was found that a 1200-kw unit could be operated simultaneously with the original equipment 123 days per year on the 1904 flowage curve and 156 days at the 1905 rate. The following table gives the maximum and minimum flowage of the Winooski River at Bolton Falls during eight months of 1904. The drainage area is 796 sq. miles.

1904.	Cu. Ft. per Second. Max.	Min.
April	5900	1700
May	6600	1000
June	1100	200
July	800	160
August	2500	170
September	2600	170
October	6900	665
November	1000	350

Full load upon three units (figuring the new machine at 1000 kilowatts) calls for 665 cu. ft. per second. The available head at the Bolton Fall plant is 51 ft. with flashboards, and 48 ft. without them.

To house the 1200-kw unit, the station building was extended about 50 ft. at an angle of about 50 degrees from the longitudinal axis of the original plant. A new penstock 11 ft. in diameter was installed on granite saddles parallel to the original penstock, and a 2200-hp, 277-r. p. m., 39-in. Allis-Chalmers horizontal twin turbine erected in June, 1907. This was direct-connected to a General Electric 12,000-volt alternator, and to handle the discharge water a 7 ft. 11 in. draft tube was installed, with an offset 8 ft. 5½ ins. maximum diameter, discharging into the tail race, as illustrated, 14 ft. from the vertical center line of the turbine. This tube is of 5/16 in. steel plate and is surrounded by concrete beyond the wheel pit. The power house addition is 38 ft. 4 ins. wide outside and is served by a 10-ton hand-power crane of 34 ft. 4 ins. span, carried on 50-lb. rails resting on 15-in. I beams. The addition is 28 ft. high from the floor to the bottom of the roof truss. A test of the generator showed a full load commercial efficiency of 95.37 per cent; three-quarters load, 94.3 per cent; half load, 92.10 per cent. The regulation was 4 per cent at full load and 100 per cent power-factor. The governor characteristic is as follows:

Load Variation.	Speed Variation.	Time, Secs.
25 per cent	2 per cent	1.5
50 "	4 "	2.
75 "	6 "	2.5
100 "	8 "	3.

A 30-kw direct-coupled exciter, wound for 125 volts, was installed with the 1200-kw unit at one end of the shaft.

The wiring and switchboard arrangement at Bolton Falls are shown in the accompanying sketch and cross-section. Flexibility of operation is here secured without sacrifice of space. Two sets of high-tension bus-bars are provided. Each generator circuit is provided with an automatic oil switch. Beyond this switch, the generator loads connect with selector switches by which each unit can be thrown upon either set of bus-bars. The two bus-bar sets can be tied together with an automatic bus junction oil switch. The outgoing feeder circuits are each provided with selector switches connecting with the two sets of busses, and in each outgoing line is an automatic oil switch to protect the station against external overloads. The switchboard is 15 ft. 6 ins. long over all, containing two

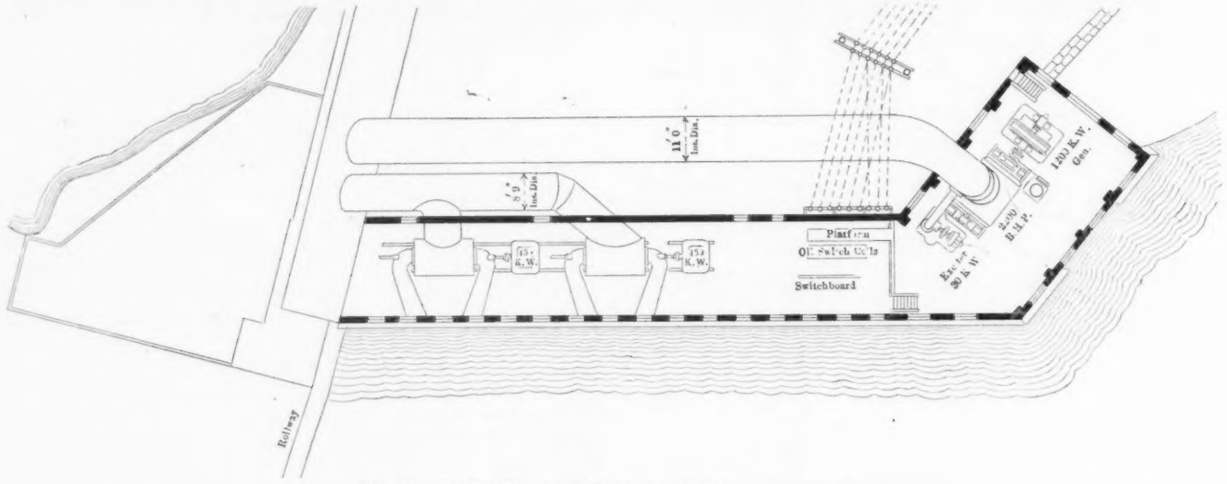


FIG. 3.—HYDRAULIC DEVELOPMENT AT BOLTON FALLS, VT.

exciter, three generator, one bus junction and three line panels. Two sets of exciter bus-bars are provided, and watt-hour meters are inserted in each generator and

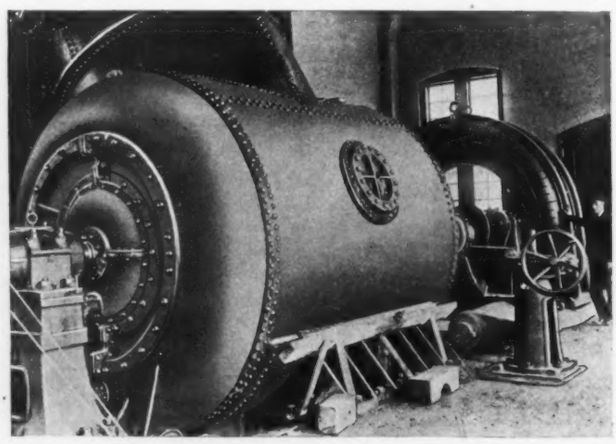


FIG. 4.—1200-KW WATER-WHEEL AND GENERATOR.

feeder circuit. Field rheostats are mounted in the basement, and the oil switches are mounted in concrete compartments installed 4 ft. behind the operating switchboard. The

bus-bars are carried horizontally on insulators supported on a pipe frame 9 ft. 6 ins. above the floor. The selector switches are all of the knife-blade type, and these are mounted between in-

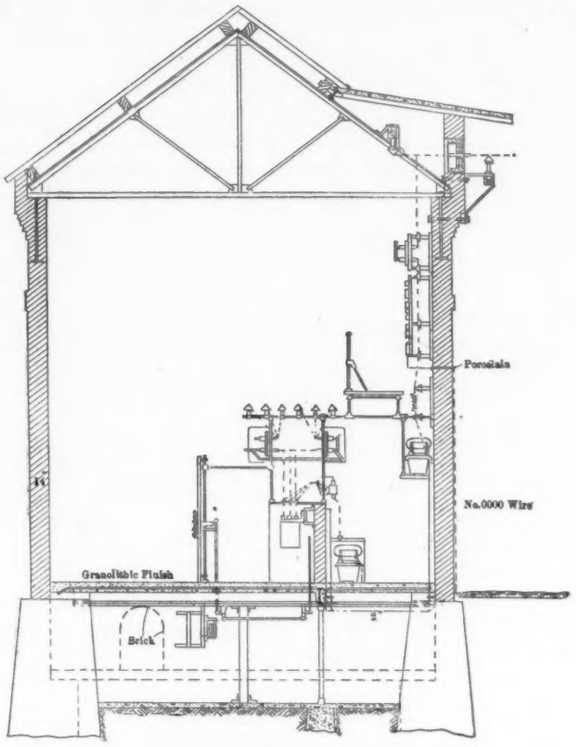


FIG. 5.—SWITCHBOARD LAYOUT, BOLTON FALLS.

sulating barriers supported just below the bus-bars on the pipe framing. The lightning arrester equipment is installed on the wall, well away from the bus-bars, and it is accessible by means of a special platform supported on the bus-bar framework. The outgoing circuits pass through porcelain and rubber bushings centered between two glass plates set in a wooden casing with cement. Angle-iron brackets fastened to the outside wall with lag bolts carry 6 in. x 8 in. cross-arms upon which the line insulators are supported, the inside insulators being mounted upside down on similar cross-arms bolted with angle irons to the roof-truss members. The lightning arrester, No. 4-0, ground is carried through the brick wall in a porcelain tube connected with the penstock by a brass plug.

A typical daily load curve of the Bolton Falls plant is reproduced herewith, the size of the log sheet being 12 ins. x 14⅜ ins. The total output for the day shown, Nov. 19, 1907, was 26,000 kw-hours, making an average load of 1082 kilowatts. The maximum load was 2050 kilowatts from 7 to 11:45 a. m.; the

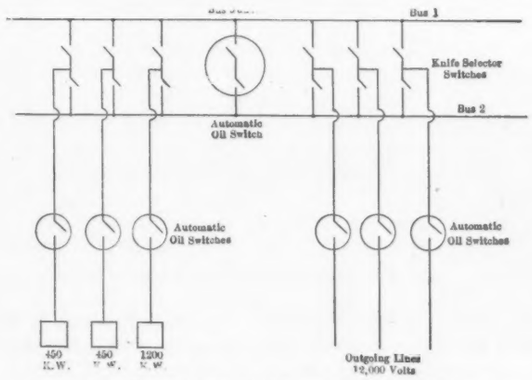


FIG. 6.—BOLTON FALLS WIRING SCHEME.

load-factor expressed by the ratio of average load to maximum load ran about 98 per cent, and from 1 to 3 p. m. the output was about 100 per cent of the maximum. The load at the granite quarries and sheds, 25 to 30 miles distant, is exceedingly even during the day. The lighting load, from 5 to 7 p. m., reached its maximum in time to bring the total plant load to 700 kilowatts, or but one-third the maximum during the day. The street lighting load of the company includes 105 arcs at 7.5 amperes in Montpelier; in Barre, 110 6.6 ampere arcs, and 275 series incandescents in the small towns.

The Pioneer steam plant at Montpelier is a steel-frame and brick structure about 80 ft. x 60 ft. It was started about four years ago, and is located on the banks of the Winooski 1.5 miles south of the center of the city. Except at times of low water the station is not operated unless an emergency arises, but one or more attendants are constantly on duty. This plant is the Consolidated sub-station for Montpelier distribution. It contains one 400-hp and two 300-hp Stirling boilers, and 1500 kilo-

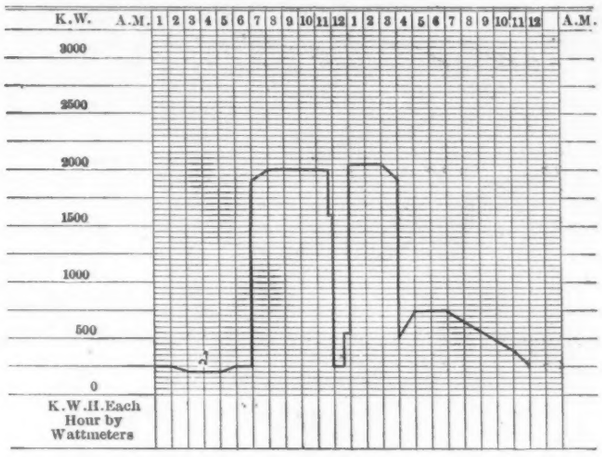


FIG. 7.—TYPICAL DAILY LOAD CURVE.

watts in generating units. One unit is a 500-kw, 12,000-volt, three-phase alternator of General Electric make, direct-driven by a cross-compound horizontal McIntosh & Seymour engine; and the other, a 1000-kw, 1800-r. p. m., 2300-volt Westinghouse-Parsons turbine. The operating steam pressure is 150 lbs. without superheat. A Wheeler condenser is used in connection with the turbine, and a Bulkley barometric condenser on the engine exhaust. There is a 25-kw exciter, 125 volts, belted to the engine flywheel, and also a 40-kw motor-generator exciter set. The boilers discharge into a horizontal smoke flue leading into

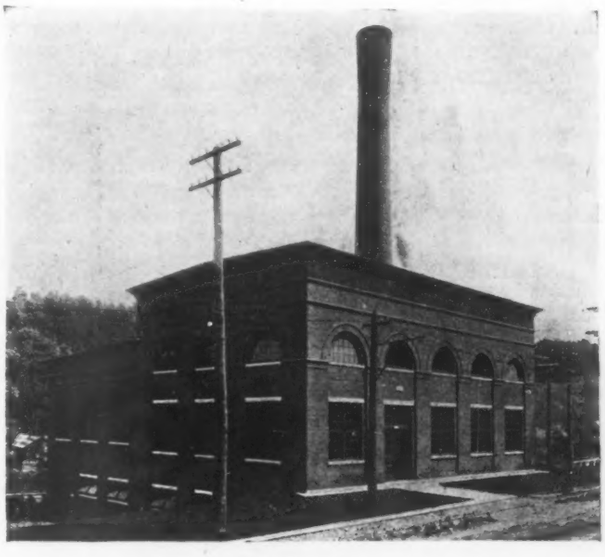


FIG. 8.—STEAM POWER PLANT, MONTPELIER.

a brick stack 125 ft. high and 6 ft. inside diameter. The boilers deliver steam through 8-in. risers to a 10-in. header running lengthwise of the room, the engine and turbine being supplied

with steam in the usual manner. A cross-section through engine and boiler rooms is shown, but the 750-kw turbine indicated has been replaced by the 1000-kw machine before mentioned.

The Barre & Montpelier Traction Company's 6-mile line between the two cities named is operated by energy from the station in Barre is shown, with the spacing and general arrangement of transformers and high-tension wiring. Incoming high-tension circuits are carried through the sub-station on bus-bars 18 ft. above the floor, and taps are brought downward from these through knife switches to the transformers on the floor

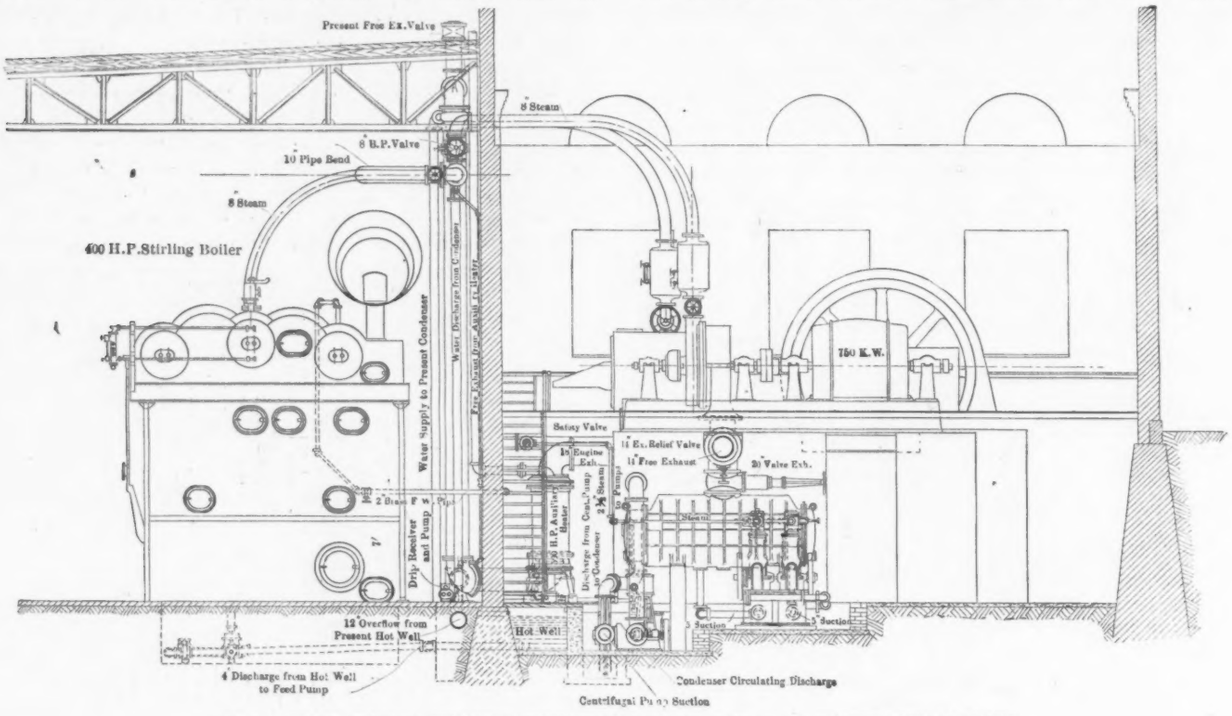


FIG. 9.—CROSS SECTION THROUGH ENGINE AND BOILER ROOMS OF PIONEER STEAM PLANT.

Consolidated Company's plants. A 150-kw motor-generator set wound for 600 volts on the direct-current side is installed at the Pioneer plant for this purpose. The motor-generator is started in the morning by direct current from a storage battery located in the car house of the railway company. The transformer equipment at the Pioneer plant includes three 375-kw, 12,000 to 2300-volt Westinghouse oil-cooled units, six 100-kw air-blast General Electric, and two 150-lamp constant-current transformers. These are so connected that the turbine can supply energy to the local 2300-volt Montpelier load and the railway motor-generator direct, and so that the engine unit can feed energy to the 12,000-volt lines in times of low water. The 375-kw units can be used to help out any sub-station as portable spare units in case of a serious brakedown. The following table gives the results of an economy test on the 1000-kw steam turbine:

B. H. P.	Lbs. steam per hp-hour.
800	16.6
900	16.1
1000	15.8
1100	15.5
1200	15.25
1300	15.0
1400	14.9
1500	14.75
1600	14.7
1700	14.8
1800	15.1
1900	15.5
2000	16.0
2100	16.5
2200	17.0

Whaley & Company, of Boston, were the engineers for the Pioneer plant.

The equipment of transformers in the sub-stations of the Consolidated and Vermont systems is as follows:

Sub-station	Number.	Kw.	Company.
Waterbury	2	50	Consolidated
Montpelier	6	100	"
"	3	375	"
"	4	125	Vermont
Barre	3	200	"
"	2	250	"
"	6	200	Consolidated
"	2	300	"
Graniteville	6	100	"

Distribution from all these sub-stations is at 2300 volts, three and single-phase. A cross-section of the Consolidated sub-level. The 2300-volt secondary lines are carried to the constant-current transformers and to the outgoing distribution circuits well cleared from the high-tension leads.

The Vermont Company's plant, at Middlesex, operates on 50-ft. head, and has a drainage area estimated at 500 sq. miles. The ultimate development is about 4000 horse-power. The equipment of this station consists of three water-wheels built by the Platt Iron Works, and aggregating 2400 horse-power; these drive two Stanley 600-kw, 2300-volt alternators and a Westing-

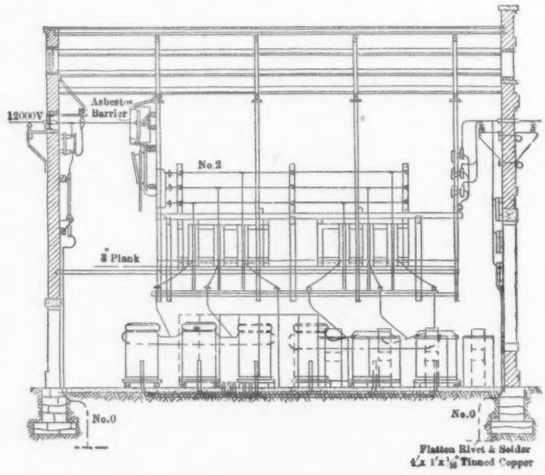


FIG. 10.—SUB-STATION AT BARRE, VT.

house 350-kw generator. Seven step-up transformers, aggregating 1550 kilowatts, raise the voltage to 15,000 for transmission over a 50-ft. right of way to Montpelier and Barre. This plant also has a 450-hp steam auxiliary generating unit, and a 200-kw spare transformer.

The transmission lines are carried on cedar poles from 35 ft. to 50 ft. in height, with 100-ft. spans. Locke glass insulators

are used, and the wire spacing was 14 ins. The transposition scheme used is illustrated in the accompanying sketch, the insulators being fastened to the upper or lower side of the cross-

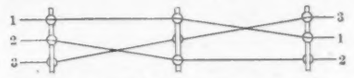


FIG. 11.—TRANSPOSITION SCHEME.

arms as conditions require. Acknowledgments are due to the management of the Consolidated and Vermont Companies for many courtesies extended in connection with this article.

The Law of Electric Light Companies.

BY JOHN E. BRADY.

ONE of the earliest questions propounded to the courts in regard to electrical companies was whether or not such companies could be regarded as manufacturing industries within the meaning of various state statutes. And a satisfactory answer to the question was made none the less easy to render by the fact that the courts were more or less at sea as to the real nature of what they referred to as the "mysterious force." A certain frankness pervades the opinions of the judiciary given in cases involving electrical questions. In one English case where the right to use the word "Electric" as a trade-mark was at issue the following confession of lack of knowledge is found: "'Electric' suggests a meaning. I do not mean to say that it has a meaning. The more one knows of electricity, perhaps, the less meaning it has. . . . The act of Parliament (relative to a trade-mark) is for an ordinary Englishman. What does the ordinary Englishman know of 'Electric' as applied to velveteen? He knows what 'Electric' is more or less, perhaps rather less than more, and he associates it with electricity. The word is obviously not meaningless, and is not in my judgment a meaningless word." In re Van Duzer's Trade-Mark, 34 Ch. Div. 623.

In the state of Colorado it has been decided that an electric lighting company is a manufacturing company within the meaning of a provision of the Constitution of that state, which bestowed upon manufacturing corporations the right to acquire property by the exercise of the power of eminent domain. Lambarn vs. Bell, 18 Colo. 346. The section of the Constitution referred to provided that property might be taken by eminent domain for "mining, milling, domestic or sanitary purposes." In this case in passing on the question the court said: "While from its derivation the primary meaning of the word 'manufacture' is making with the hand, this definition is too narrow for present use. Its meaning has expanded as workmanship and art have advanced; so that now nearly all artificial products of human industry, nearly all such products as have acquired changed conditions or new and specific combinations, whether from the direct action of the human hand, from chemical processes devised and directed by human skill, or by employment of machinery, which, after all, is but a higher form of the simple implements with which the human hand fashioned its creations in ruder ages, are now commonly designated as manufactured."

An Alabama statute provided that "any two or more mining, quarrying or manufacturing corporations may unite or consolidate their capital stock, property and business." The question was brought up whether electric light companies were manufacturing corporations so as to be entitled, under the statute, to consolidate. The case was that of Beggs vs. Edison Electric Illuminating Company, 96 Ala. 295, and it was held that the statute was intended to cover such companies. In reaching this conclusion, the producing of electricity was compared to the manufacture of gas for illuminating purposes, and Stone, C. J., who delivered the opinion of the court said: "When it is attempted to establish the proposition that the gas which lights one room is a manufactured product, and the electricity which lights another room is not, one is obliged to rely more on the definition of terms and the distinctions of scientists than on the actual, practical processes and productions, by means of which results in all respects, or at least substantially, the same are produced. When we take into consideration that the electricity now used and supplied in the ordinary business of life is essentially the product of skill and labor, we can find no difficulty in reaching the conclusion that a corporation engaged in generating, storing, transmitting, and selling such electricity is a manufacturing corporation." And further, "the electricity that exists in nature is of a very different quality than that produced by means of machinery. The mysterious power generated by machinery is transmitted and lights streets and private houses. The electric current that brings about these results cannot be said to be 'the free gift of nature, gathered from the air or the clouds.' It is the production of capital and labor, and in this respect cannot be distinguished from ordinary manufacturing operations. The collection, storage, preparation for market, and the transportation of ice, is not manufacturing; but the production of ice by artificial means is." People vs. Knickerbocker Ice Co., 99 N. Y. 181. As well say that a gas company, organized under the corporation laws, is not a manufacturing corporation because both gas and the electricity generated are the result of artifice."

In New York it has been held that an electric company was exempt from taxation under a statute exempting manufacturing corporations from the payment of taxes. People vs. Wemple, 129 N. Y. 543. The effect of this decision, however, has since been nullified by statute. A different result has been reached by the courts of Maryland, where it was decided that an electric light company could not claim the benefit of a statute exempting manufacturing corporations from taxation. In the case of the Frederick Electric Light Co. vs. Frederick City (84 Md. 599), the Court of Appeals did not deem it necessary to attempt a scientific discussion of what electricity is, and placed no reliance upon encyclopædias, dictionaries or other books attempting to define it. The court proceeded upon the theory that the ordinance at issue was passed for the purpose of encouraging the establishment and development of manufactures and manufacturing industries and decided that the electric light company did not come within the meaning of the ordinance. The ordinance was held to refer only to such companies as manufactured articles for sale and which might, from a very small beginning, develop into a very large concern, resulting in great benefit to the community, through the extensive employment of labor and the distribution of considerable sums of money. A company organized to manufacture armatures, lamps or other electrical appliances, it is said, might fall within the purview of the exemption, but as the plant of the electric light company was one which could be operated by a few men, it was held not to be entitled to the exemption.

A Pennsylvania statute (Sec. 20, Act of June 30, 1885), provided for the exemption from taxation of the capital stock of manufacturing corporations, not engaged in the manufacture of liquors or of gas. The Northern Electric Light & Power Company, which was engaged in the business of furnishing electric energy to consumers for private use, claimed to be thereby exempted from tax. In deciding the question whether the electric light company was a manufacturing industry, the following facts were found by the court: "The electricity which furnishes the light does not exist until the armature revolves. The revolution of the armature brings into being something that did not exist before; that is, this electric energy or energy in this electrical form. But its source, in the philosophic sense, is the latent energy of the coal. If the coal is not burned, we cannot have the engine move, nor the dynamo, and, therefore, we cannot get the electricity; and the electricity is derived, as its prime origin, from the coal, but not, however, extracted from the coal. It was not there, but created by utilizing the latent energy of the coal." It was held, nevertheless, that the electric light company was not a manufacturing concern, such as was intended for exemption by the statute. The apparent object of the statute was to coax manufacturing corporations within the boundaries of the state, and one reason given for

not including electric light companies within the general invitation implied in the statute was that exempting them from taxation would probably not bring capital into the state, and taxing them would certainly not drive it out. It was ingeniously argued in behalf of the company, that, if it was not engaged in the "manufacture of electricity," it could not be denied that it was engaged in the "manufacture" of light. But the court, after citing authority to the effect that light is not a substance, concluded that light could not be the subject of manufacture. "It might, with the same reason, be claimed," said the court "that, in the use of the telephone, sound is manufactured, as that, in the use of electric lighting apparatus, there is a manufacture of light." With reference to electricity, as a manufactured commodity, it was said: "Whatever electricity may be, it seems to be absolutely within the power, and under the control of the company that brings it into being. Its manifestations are both seen and felt. It moves with incredible velocity and power. It carries the tones and inflections of the human voice, or moves loaded cars. It may be in the hands of a physician a soothing remedial agent, and, in the hands of the law, an instrument of execution, swifter and surer than the headsman's axe. It may be too early (1891) to say just what it is." Commonwealth vs. Northern Electric Light & Power Company, 145 Penn. St. 105.

REGULATION AND CONTROL.

The regulation and control of electric lighting companies, in respect to their use of the streets, is generally delegated by the state to the municipal corporations within its borders. Such companies are always subject to reasonable regulations by the proper authority. Thus they have been compelled to transfer their wires from poles to conduits, and to supply electric energy to premises within a certain distance of their wires.

The question of the validity of section 58, chapter 405, Laws of New York, 1899, which authorized the city of Geneva to require electric wires to be removed from poles and placed in conduits, came up in the case of City of Geneva vs. Geneva Telephone Company, 62 N. Y. Supp. 172. Under the statute mentioned, the board of public works had passed a resolution directing various electrical companies to place their wires in conduits constructed by the city, and the defendant company refused on the ground that the high-tension wires, which were also ordered into the conduits, would impair the operation of the defendant company's system. The statute was attacked by the counsel for the company on the theory that it was unconstitutional in that it resulted in depriving the company of its property without due process of law. On the trial it was shown that the city had constructed suitable six and nine-duct conduits, with manholes, laterals and distributing points, and that the change would not impair the defendant company's service. And it was held that the right to order the removal was within the police power of the state, which power the state had, in this instance, delegated to the municipality. It is generally the police power which the governing body invokes when it desires to compel electrical or other companies to change the established order of things. This power is incapable of exact definition, but its existence is essential to every well-ordered government. By the exercise of it the legislature maintains a supervision over matters involving the common weal, and enforces the observance by each individual member of society of the duties which he owes to others and to the community at large. It may be exercised whenever necessary to secure the good order or the general welfare of the community; and the propriety of its invocation within constitutional limits is purely a matter of legislative discretion, with which the courts cannot interfere. The rule is that where one devotes his property to a use in which the public has an interest, he must submit to be controlled by the public for the common good to the extent of the interest he has thus created. The public is interested in the safe and proper construction and maintenance of electric wires, and hence the Legislature may make rules and regulations for their proper management and operation.

While electric lighting companies may be required by statute to furnish energy to any premises within a certain distance of their wires, or to forfeit a penalty to the aggrieved party for a failure to do so, a statute, so providing, will always be construed, so far as is possible, in favor of the company. The Laws of New York, 1890, chapter 566, section 65, provided that an occupant of premises located within 100 ft. of the wires of any electric light company might require the company to supply him with energy, and established a penalty for a failure on the part of the company to act within ten days. An action was brought against the Champlain Electric Company to recover the penalty made by the statute by one whose property was within 100 ft. of a wire of the company which carried electricity for street lighting purposes only, and which could not be used for the purpose of supplying electricity for the lighting of houses or other domestic purposes. The nearest wire of the company from which the party could have been supplied with electric energy was about 1700 ft. distant from his premises. It was held in this case that the statute was for the benefit of persons whose premises were within 100 ft. of wires of the company, from which the energy required could be supplied, and that the penalty could not be collected. Moore vs. Champlain Electric Company, 85 N. Y. Supp. 37.

In another case, involving the same legislative enactment, the person desirous of being accommodated with electric energy informed the company by letter that if he did not hear from the office thereof with reference to his request within 48 hours he would start suit. To this he received the following terse reply: "If you wish to do business with us, you know where our office is." He then made a formal request, referring in his letter to the statute, but he did not state how many lamps he wished, and he failed to respond to the company's subsequent letter of inquiry as to how much energy and how many lamps were required. On the trial of the action brought for the penalty it was held that the company was entitled to know what amount of energy and how many lamps were wanted and that, not having been furnished with that information, the company could not be held for the penalty. Andrews vs. North River Electric Light & Power Company, 53 N. Y. Supp. 810.

In the case of Electric Improvement Company vs. City of San Francisco, 45 Fed. Rep. 593, it was held that the city authorities, by virtue of the police power, could enact and enforce an ordinance prohibiting electric companies from stretching wires over and upon the roofs of buildings. The court, having reference to the ordinance which contained the prohibition, in a statement which now suggests the recent conflagration in San Francisco, said: "I do not think that it violates any provision of the National Constitution. I regret to be obliged, by this decision, to affect so seriously the interests of the enterprising parties who are endeavoring to supply our citizens with electricity for the various purposes to which it is now applied. But I cannot decline to administer the law as I find it, for the safety and security of the lives and property of the citizens of San Francisco."

It cannot now be questioned that municipal corporations may make all reasonable regulations for the location and use of electric wires in their streets, and require all reasonable safeguards for the protection of the general public; and, in pursuance of this power, municipal governing bodies may require electric lighting companies to put up guard wires at certain specified places. Wisconsin Telegraph Company vs. Janesville, 87 Wis. 73. In Monongahela Electric Light Company vs. Monongahela, 12 Pa. County Ct. Rep. 529, it was decided that the City Council had the right to require an electric light company to change the location of its poles, although the poles had been located where they were by permission of the city under a legislative grant. The change in the location of the poles was made necessary by the widening of the street along which they were erected. It was held that the City Council could not grant a privilege that would in any way curtail the city's power to make future necessary improvements in the streets. It was said by the court: "To say that because the city had directed the poles, when first erected, to be placed on a certain line, it could never direct their location changed, in order to improve a street,

according to a plan duly agreed upon for the public convenience, would be to say that, where a local private corporation once placed its poles upon a street under a legislative grant, the street could never be improved so as to require a change of the location of these poles."

CONSTRUCTION OF CHARTER.

The charter of a company engaged in the manufacture or sale of electricity for lighting will be strictly construed against the incorporators in reference to the powers secured to the company by the charter, the exclusiveness and the perpetuity of the franchise, and the performance of the conditions upon which the privilege is conferred. 15 Cyc. 467; Empire City Subway Company vs. Broadway Company, 33 N. Y. Supp. 1055; Scranton Electric Light Company vs. Scranton Illuminating Company, 3 Pa. County Ct. 628—both cases holding that the rule that the grant of a franchise will be construed rigidly against its supposed exclusiveness applies to companies engaged in the manufacture or sale of electricity with the same force as to other corporations. It has been held that a company organized before electricity was generally used for lighting will not be regarded as possessing the power of furnishing light by this means, even though the words used in the articles of incorporation are broad enough to be construed otherwise, had this method of lighting been in common use at the time of the granting of the charter. Carthage vs. Carthage Light Company, 97 Mo. App. 20. In the case cited the city of Carthage, by an act of the Legislature of that state, passed in 1875, was authorized to provide for lighting its streets, either by erecting a plant itself, or by granting to some one else the right to do so. The Kansas City Court of Appeals decided that the city did not thereby gain the right of granting a franchise to a company organized to supply electric light, the reason being, as stated, that the Legislature could not have contemplated the granting of such a power, as street illumination by electricity was not regarded as a feasible plan at the time the statute was enacted. In Brush Electric Light Company vs. Jones Brothers Electric Company, 10 Ohio Dec. (Reprint) 767, it was held that the authority to engage in the business of electrical illumination must be clear and explicit, and will not be implied from authority in the charter of a company to manufacture and operate dynamos, motors and other electrical appliances, or to manufacture, buy and sell telegraph and electrical appliances and engage in "general light manufacturing."

If certain acts, or the compliance with certain conditions, are made necessary for the acquirement of the privileges secured to an electric light company by its charter, then the company must fully perform the conditions imposed before claiming the benefits of its franchise. The ordinance by which the city of Philadelphia authorized the Kensington Electric Company to occupy the streets of the city for the erection of its poles, and to pursue the business of supplying electricity, required the company, as a condition to the enjoyment of the privileges conferred, to supply electric light to all public buildings within a certain territory used as police and fire stations, without charge to the city. At the time of the adoption of the ordinance there were three buildings within the territory used as police and fire stations. Shortly thereafter a new building was erected to take the place of one of the old ones. The city requested the company to wire and light the new building, but the company refused to comply, claiming that it was required by the ordinance to light only such buildings as were used at the time of the enactment of the ordinance for police and fire stations. The ordinance was construed against the company, and held to apply to all city buildings used as such stations, whether erected before the passage of the ordinance or after; and it was also held that the city officers might refuse to sign the orders necessary to enable the electric light company to obtain warrants for the bills for lighting the streets of the city, in accordance with the contract between the city and the company, until the company should comply with the provisions of the ordinance, as construed by the court. Kensington Electric Company vs. City of Philadelphia, 41 Atl. Rep. 309.

Direct-Current Motors, Their Action and Control—III.

BY F. B. CROCKER AND M. ARENDT.

SHUNT MOTOR STARTING BOXES.

IN starting shunt and compound-wound motors, no trouble is likely to occur in connecting the field coils to the circuit because their resistance is high. The difficulty is with the armature, its resistance being very low in order

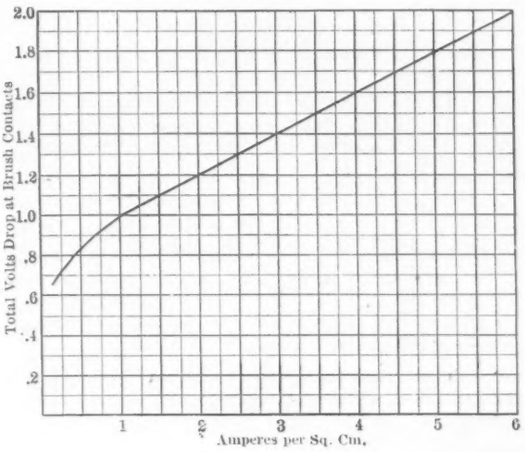


FIG. 1.—VOLTAGE DROPS AT CONTACTS FOR CARBON BRUSHES.

to obtain high efficiency and good speed regulation, as already shown. If a low resistance winding be directly connected across the line terminals, the "inrush current" would be so excessive that it would tend to injure or destroy it. When standing still an armature generates no c. e. m. f. so that the

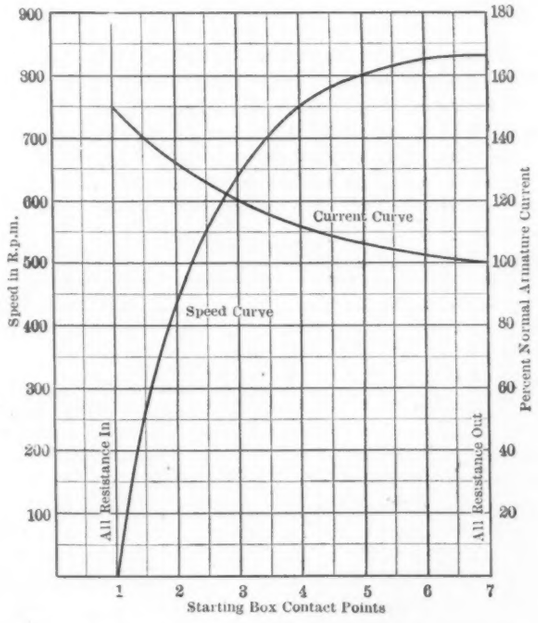


FIG. 2.—SPEED AND CURRENT STARTING-BOX CURVES.

entire voltage must be consumed in the armature resistance ($I_a R_a + D_b$). To prevent this injury and at the same time to obtain gradual acceleration, an adjustable rheostat commonly called a "starting box," is inserted in series with the armature, the resistance of which is gradually reduced as the speed increases. As a rule, starting

boxes, unless otherwise specified, are designed to allow the motor to draw an initial current about 50 per cent greater than the normal value, so that the machine may develop ample torque to start under load. The following example indicates the method of determining the various values of the resistance required in the starting box. Assume that the 10-hp motor, the data of which have been given, is to be started from rest under load, that the current and "speeding up" curves desired are those shown in Fig. 2. The current curve gives the current values desired at the various positions of the contact arm of the starting box, seven in all, decreasing gradually from 50 per cent above normal at start to rated current at rated speed. The speeds at the corresponding points are obtained from the speed curve in Fig. 2. These values, obtained from the curves, are tabulated as follows:

V volts.	R. p. m.x / R. p. m.r = c. e. m. f.r = c.e.m.f.x / volts	Armature drop. $I_a R_a$. volts.	Brush drop. D_b volts	External drop. $I_a R_x$. volts.	External resistance R_x ohms.	Starting Box. Position of Arm
230	$\frac{0}{825}$—218.2=0	55. 5× .281=15.6	1.71	212.7	3.83	1
230	$\frac{450}{825}$—218.2=119	49. 3× .281=13.8	1.60	95.6	1.94	2
230	$\frac{640}{825}$—218.2=169	44. 5× .281=12.2	1.50	47.3	1.06	3
230	$\frac{750}{825}$—218.2=198.5	41. 7× .281=11.7	1.45	18.35	.44	4
230	$\frac{800}{825}$—218.2=212	39. 5× .281=11.1	1.43	5.50	.14	5
230	$\frac{820}{825}$—218.2=217	37.75× .281=10.6	1.41	1.00	.027	6
230	$\frac{825}{825}$—218.2=218.2	37 × .281=10.4	1.40	0	0	7

STARTING 10-HP MOTOR UNDER LOAD.

Position of Contact Arm.	Armature Current Per Cent of Rated Value.	Armature Amperes.	Speed in R. p. m.
1 All resistance in	150	55.5	0
2	133	49.3	450
3	120	44.5	640
4	112	41.7	750
5	106	39.5	800
6	102	37.75	820
7 All resistance out.	100	37.00	825

The motor speeds at the various contact points being assumed as above, the c. e. m. f. corresponding to these speeds can be readily determined by substituting them in equation VIII. Knowing the c. e. m. f. and taking the corresponding values of armature drop, also the brush contact drop from the curve in Fig. 1, the voltage drop ($I_a R_x$) in the external resistance R_x can be calculated from the following equation giving the relation between action and reaction in the armature circuit of a direct-current shunt motor:

$$V = \text{c. e. m. f.} + I_a R_a + D_b + I_a R_x \qquad \text{(IX)}$$

Motor starting boxes are not designed with large radiating surfaces, because the box is supposed to be in use only for very short periods (15 to 30 seconds at one time). The chief precaution is to have the resistor units of such current-carrying capacity that they do not become injured by a momentary overload current of 50 per cent above the rated value. Practically the box should be designed to act a certain number of times per hour, without injury. If the contact arm of the starting box is moved too rapidly over the resistor points, the armature current would be excessive and injury might result, hence the starting period of 15 to 30 seconds as stated.

In case a motor is to be started without load, the starting resistances calculated before would not bring up the speed gradually, because the initial $I'_a R_x$ drop would be only 3.83 × 2.3 or 8.8 volts, so that the c. e. m. f. with total box resistance in circuit and at no load current, would be 230 — 10.2 = 219.8 volts and the corresponding motor speed would be (219.8 ÷ 218.2) 825 = 832 r. p. m. Hence the motor would almost instantly run at a speed greater than at rated load. For this reason, to start a motor without load, it is sometimes the practice, especially in Europe, to use a special box, the resistance of which is much higher than in the preceding design. For instance, if it were desired to have the "speeding up" curve at no load of the same shape and corresponding values as that in Fig. 2, the required external resistance would be those given in the accompanying tables.

A comparison of the low resistances of the first starting box with the high values of R_x, shows the great difference between the two types and makes it evident that one should not be used indiscriminately for the other. If the latter type of box were employed to start a motor under load (for example at rated torque), the armature current would be far less than the rated value until next to the last contact point was passed, when the armature would suddenly jump to rated speed, a change much too sudden and likely to injure the motor or the machine driven by it. For this reason, and to have the starting box adapted to all load conditions, the American practice is to use a box designed to start the motor under load. Thus, while the speed may rise rather suddenly without load, no injury will result, because the initial (*i. e.*, total) resistance is sufficient to limit the armature current to a reasonable value and the speed does not rise more than about 3 per cent above rated value. Rapid acceleration without load is not objectionable, provided

R. p. m. at no load.	Armature Current amperes.	C. e. m. f.x = R. p. m.x / R. p. m.r c. e. m. f.r volts.	Armature Drop $I'a$ Ra. volts.	Brush Drop $D'b$. Volts	External Drop $I'a$ Rx. Volts.	External Resistance Rx. Ohms.	Starting Box Points No.
0	2.3	0	.56	.84	228.6	99.4	1
450	2.3	$\frac{450}{825}$—218.2=119.	.56	.84	109.6	47.6	2
640	2.3	$\frac{640}{825}$—218.2=169.	.56	.84	59.6	25.9	3
750	2.3	$\frac{750}{825}$—218.2=198.	.56	.84	30.6	13.3	4
800	2.3	$\frac{800}{825}$—218.2=212.	.56	.84	16.6	7.2	5
820	2.3	$\frac{820}{825}$—218.2=217.	.56	.84	11.6	5.0	6
865	2.3	$\frac{865}{825}$—218.2=228.2	.56	.84	0	0	7

neither current nor speed is excessive. On the other hand, the motor is fully protected when started under load, the armature current having sufficient strength to gradually bring the armature up to speed.

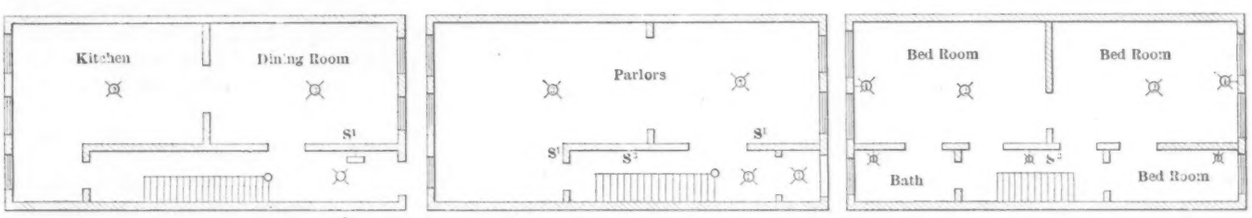
Wiring of Residences at Small Cost.

BY THOMAS W. POPPE.

ONE of the chief drawbacks to the introduction of electricity in the residential sections of cities is the cost of installing the wires, etc. This of itself would not be serious were it not for the fact that after the ordinary wireman has finished his work, the owner has decorations, plastering and flooring to repair owing to the bungling work of the electrician. This necessitates oftentimes having a painter, a plasterer and a carpenter. If an owner is assured that a system of wiring can be installed that does not entail these after expenses and which will not inconvenience the occupants of the house to any appreciable extent, the chances are that the house will be wired if the advantages of so doing are properly presented.

A residence can be wired in this manner by using practical knowledge and skill, but to perform the work at a low price it must be done on an extensive scale, as many original material units must be used and these must be made in quantities to keep the cost as low as possible.

The following explains how a seven-room dwelling can be wired at little cost and without damage to walls, decorations or floor. Figs. 1, 2 and 3 show plans of the basement, first floor and second floor of an ordinary city house. The service wires should enter the building in the cellar and should the electric light company's mains be overhead this can be done cheaply by running a line of conduit up to the second story outside the building, as shown in Fig. 4. The reason the conduit should be fastened to the house is that it avoids cutting through any grass plot or flower garden which might be on the front of the property, and does not necessitate a permit to open the street. Again, an owner might object to the cutting of holes through the front of his building for the entrance of wires. The service being in the cellar, the meter would also be there, thus forestalling any objection the owner might raise should it be set in a room, though housed in a cabinet. The mains should be drawn through the conduit into the cellar, where the meter is to be placed. The strain should be taken from the conduit by means of a fitting, as shown in Fig. 4. This is made in two pieces and can be placed in position after the wires are drawn in. The conduit should then be painted the same shade of color as the building, so as to render it less conspicuous.



FIGS. 1, 2 AND 3.—PLAN VIEWS OF BASEMENT, PARLOR AND TOP FLOORS.

From the meter a two or three-conductor steel-armored cable, as the system of the electric light company may require, should be brought up through the basement floor to a panel box in the basement hall. The location of the box is shown in Fig. 1. Damage can be avoided in doing this by boring through the basement floor close to the baseboard and through the cellar ceiling with a small-diameter gimlet bit. From the hole thus made in the cellar ceiling measure three inches toward the partition in the basement. A hole of sufficient diameter to allow the cable to slip through it easily should be bored up through the ceiling and through the flooring into the middle of the partition. This hole should be bored plumb. If this precaution is not taken the auger bit might find an exit through the plaster of the partition. The plaster where the panel box is to rest should be cut the exact size of the box with a compass saw and the box should be exactly over the hole bored through the floor. The armored cable should not be drawn in until the box is set, as the weight of it resting on the plaster will chip the plaster, and this is to be avoided. The box when set should be flush with the plaster.

There are three circuits; one for the basement, one for the first floor and one for the second floor. In the basement, which includes the kitchen and dining room, there are four outlets: one for an electrolier in the dining room, one for a switch to control the electrolier, one for an electrolier in the kitchen, which is controlled at the lamps by key sockets, and one in the hall, which is also controlled at the socket. If the ceiling is low the electrolier in the hall should be placed on the side wall. If the ceiling is high, the sockets should have a chain pull to operate them.

To prepare for the installation of the circuit conductors it is necessary to take up a pocket in the floor directly over the panel box, and bore directly downward through the partition plate. This will bring the auger in a hollow place formed by the two upright studdings and the lath and plaster. Should a bridging be encountered when drawing in the cables a hole can be bored through it by using an extension piece in addition to the auger. Fig. 5 shows a bridging, being bored in this way. As an ordinary extension piece has a clutch attached which would be too large to pass through the size of hole necessary (about 7/8 in.) it is a good plan to fit the auger into one end of a piece of 3/8-in. (inside measurement) gas pipe and bore a hole through both the pipe and bit. Then remove the auger and tap the hole in it for a standard machine screw; enlarge the holes in the gas pipe so the machine screw will pass through them, replace the auger, and put the screw in place. The other end of the gas pipe can be shaped to fit the chuck on the brace.

While boring the hole on this floor, it is advisable to bore for the entire number of tubes going upwards. In the dining room carefully remove the old picture moulding and in its place install picture moulding grooved for the insertion of electric wires. This moulding can be purchased at any reliable supply house. The same kind of moulding should be placed in the kitchen. Fig. 6 shows a side view of electrical picture moulding with the capping removed. It is necessary to install the grooved picture moulding only where the wires are to be carried, as solid picture moulding of a like design can be obtained to finish the room. In the moulding directly over the panel box, but on the opposite side of the partition, an oblong hole should be cut so a box as shown in Fig. 7 can be placed therein. This hole should continue through the plaster and lath. This box has a flexible tubing connector already attached and is fastened at an angle to point upwards or downwards as the case may require so as to be used as a pull box, the rules of the underwriters requiring this when the system of wiring is changed. A steel-armored twin-conductor cable should be installed between this point and the panel box. The pull box, Fig. 7, has a cover to avoid danger from fire and the wooden capping is fastened over it showing no part of the box. The cable can be installed by pushing a "snake" through the oblong hole in the moulding, directing it downward to the opening made for the panel box. The cable should then be attached and drawn upward through the oblong hole. The steel armor of the cable should be removed for a distance of about six inches

and the wire drawn into the pull box through the connector before setting the box. The cable should be fastened in the connector by means of the set screw.

For the hall outlet a hole should be cut in the ceiling the exact size of the box, which is about three inches in diameter and two inches deep, and which is equipped with clips which grip the cable and hold it fast. Between this box and the moulding in the dining room a steel armored cable should be drawn between the beams above the plaster, to a point where another pull box (Fig. 7) is placed in the moulding. To do this it is necessary to bore through the ceiling partition plate from, above, taking up a pocket. It is better if two pockets will come close together to extend one so as to make it serviceable for both. The cable may be drawn in as before, leaving about four or five inches excess to facilitate connecting it to the outlet box;

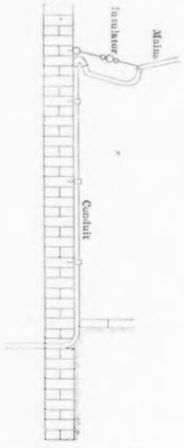


FIG. 4.—SERVICE ENTRANCE.

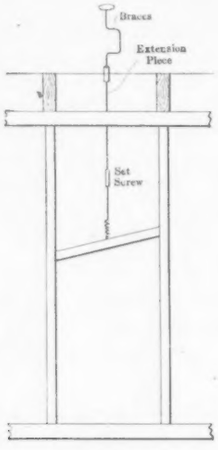


FIG. 5.—BORING BRIDGING.

it being only necessary for the workman to fasten it by means of the clips mentioned and push it into the opening made for it in the ceiling, allowing the surplus cable to curl up in the space above the plaster. As most residences are piped for gas the box may be fastened by slipping a proper-sized collar over the gas pipe after the box is placed in position and fastening it there by tightening the set screw in the collar. This box should be flush with the plaster. Fig. 8 shows the box in position.

The outlet box for the electrolier in the dining room is set in a similar manner. The switch to control this electrolier is set by cutting a hole in the plaster the size of the switch box and placing a mat around the hole and two pieces of wood inside. The mat is screwed to the two pieces of wood, which serve as a clamp. The wooden strips should be vertical, as they clamp more strongly to the lath running horizontally. Fig. 9 shows the switch box set and connected. In the kitchen the oblong hole is cut in the moulding on the side of the room the same distance from the rear wall of the building as the center

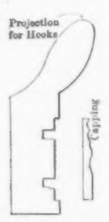


FIG. 6.—MOLDING.

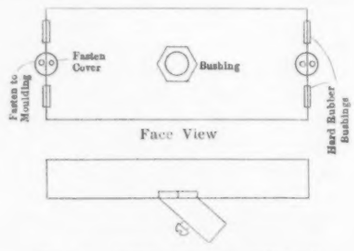


FIG. 7.—PULL BOX IN MOLDING.

of the room. This allows the cable to be drawn between the beams to the center of the room where a box is set as in the hall and dining room. It is necessary to take up a pocket directly over the oblong hole in the moulding. These pockets can be taken up very easily by using a sharp, thin, fine-toothed compass saw. When replaced, the pocket fits neatly, owing to the small amount of wood removed by the saw. Most wiremen carry, if they have one at all, a thick-bladed saw with a large set in the teeth. This, as a rule, is very dull. When a pocket

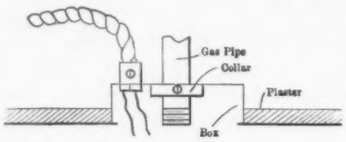


FIG. 8.—BOX IN POSITION.

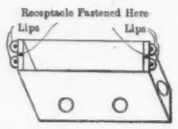


FIG. 11.—BASE-BOARD BOX.

is cut by a saw of this kind and replaced, it leaves an opening between the ends which is objectionable.

At the pocket in the hall directly over the panel it may be found necessary to cut the floor partition plate, and to do this it may be necessary to bore upwards between the beams using a ratchet similar to that used by iron workers for drilling holes in a beam. The auger can be placed in a chuck of the ratchet and the screw of the ratchet placed against the partition plate of the ceiling below. By using the ratchet it is an easy matter to bore upwards through the floor partition plate. These plates consist of 2 in. x 4 in. joists which are placed on the floor and against the beams overhead with the uprights wedged between them. They are also nailed in position. The ceiling plate on this floor is bored in the same manner as the one below; a pocket being taken up overhead. A snake consisting of a piece of heavy rattan, with a small hook fastened to the end, is pushed downward. The rattan is used because it is strong and while being somewhat flexible does not coil up like a steel snake, and is more convenient for finding the hole in the bridging and floor plate. The object of attaching the hook to the rattan is so it can be "fished" by using a steel spring or snake should it be difficult to find the hole in the floor with the rattan snake. It is also useful for fastening a sash cord preparatory

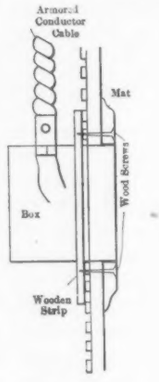


FIG. 9.—SWITCH BOX

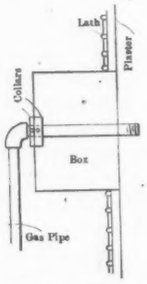


FIG. 10.—BOX AT BRACKET.

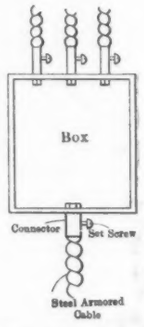


FIG. 12.—PANEL BOX.

to drawing in the steel-armored cable. The necessary circuit feeders can be drawn in this manner. The electrolier outlets on each floor are set in the same manner as those in the basement.

Where a bracket is desired an extra deep box may be installed and the connection made as shown in Fig. 10. The box is fastened by means of a collar on the gas pipe behind and one inside the box. Any slight opening around the box may be filled with plaster of Paris. This should be done with all the outlet boxes. The cable is drawn into the box from a pull box placed in the moulding directly over it.

Where a base receptacle is required it is usually most convenient to place it under a bracket outlet. In such a case the conduit is continued from the bracket outlet to the receptacle. A small oblong hole is cut in the baseboard and a box similar to one shown in Fig. 11 inserted therein and fastened with wood screws passing through the lips shown.

If it is necessary to carry the wires through a partition as between the parlor and rear parlor, two boxes (Fig. 7) can be

installed in the moulding, one on each side of the partition, and a piece of steel-armored cable used to connect them. The cable is held fast by means of set screws in the connectors attached to the box.

The panel box in the basement hall is fastened to projections from the upright studdings on each side of the box. The trim and door of the panel are fastened to the box and the trim extends four inches beyond it to cover any crevice between the box and plaster or any damage done to the decorations.

The steel-armored cable is fastened to the panel box by means of long-necked connectors as shown in Fig. 12.

With the above system installed as outlined, no damage is visible and to the average person this is equivalent to no damage being done. If a solicitor, when seeking new business among the unwired residences, can show a house thus wired to a prospective customer it will greatly aid him in getting a signature to a contract.

The Operation of a Small Electric Plant.

By W. H. WAKEMAN.

DIRECT-CONNECTED DYNAMOS.

IN many manufacturing plants where it has been decided that the introduction of electricity will prove a good investment, it is a wise plan to install a direct-connected dynamo in order that the electric lighting service may not be dependent on the main engine. The high-speed engine drives the dynamo at an almost constant number of revolutions, resulting in a uniform voltage, because the centers are passed so quickly that the speed does not drop enough to make the lamps flicker. Taking for a standard a speed of 300 r. p. m., ten centers are passed a second, therefore the speed is very steady and satisfactory as long as the machinery is kept in first-class order.

Another reason for the adoption of direct-connected dynamos is that it is possibly to obtain electricity without starting up the main engine for this purpose, or keeping it in motion when otherwise it might be shut down. This is very convenient when repairs must be made at night, when new machinery must be installed while the main shafting is not in motion, or at any other time when light alone is needed. In the case of mills and factories located in small villages, the dynamo is run during the evening to supply electricity to some of the houses, and perhaps a few arc lamps on the main street.

The intelligent engineer who has been running an engine that revolves 60 or 75 times per minute will find it a different proposition to care for one that runs four or five times as fast. Still there is no reason for apprehension, as it is only necessary to use about five times as much oil on the high-speed engine as on the low-speed engine, and give it attention in about the same proportion. This does not necessarily mean that the expense of oil will be increased in this proportion, as the oil can be filtered and used over again. The oil, however, must be fed rapidly to the bearings in order to keep them cool Some persons consider it economical to buy a cheap oil, use it once and then throw it on the coal pile; but that this is uneconomical the following comparison shows. If oil that costs 15 cents a gallon is used once, the cost represents the expense of one lubrication of the parts. Using an oil costing 50 cents a gallon ten times, reduces the cost per single lubrication to 5 cents, and this is within reasonable limits.

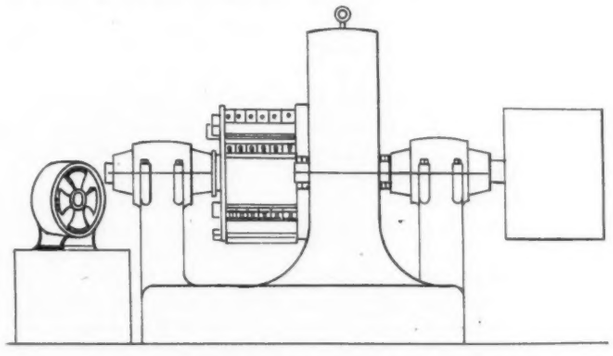


FIG. 1.—ARRANGEMENT FOR COOLING BEARINGS.

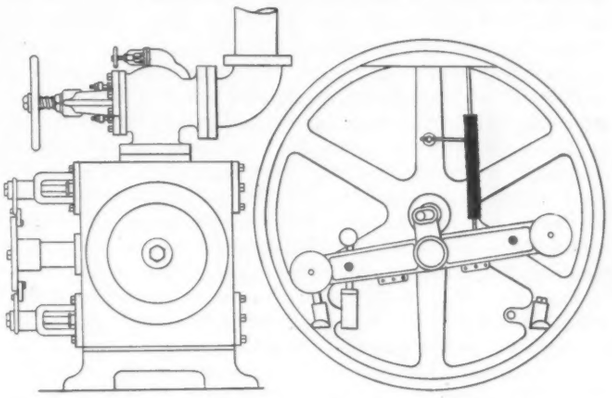


FIG. 2.—ANGLE THROTTLE VALVE. FIG. 3.—FLY-WHEEL GOVERNOR.

One of the best ways to cool a bearing that has commenced to heat is illustrated in Fig. 1. It represents a desk fan blowing air into the bearing, and although this is comparatively hot air taken from the warm engine room, the fact that it circulates rapidly causes it to carry off much heat. At the same time the supply of oil must be increased to a stream, and it may become necessary to use cylinder oil, although this is to be avoided if possible, because cylinder oil is so much thicker that it ought to be kept separate. Some high-speed engines are designed with the babbitt metal of the main bearings in separate pieces; therefore, if one of them is accidentally melted out, another can be inserted at short notice.

More cylinder oil is generally used in high-speed engines than in the low-speed engines, partly because wear on the valve gear is excessive at high speed. When the smallest number of drops of oil per minute that will thoroughly lubricate the internal parts of an engine is determined, it is only a waste to use more. If the valve of a high-speed engine works hard, it makes the fact known by small knocks and pounds, and if more cylinder oil reduces this noise, it ought to be used as a measure of comfort and economy.

A certain plant contains an old-fashioned low-speed engine of substantial design that has proved satisfactory for 14 years, except that it does not govern perfectly under changes of load. The piston of this engine contains 28 pieces, preventing leakage of steam, and making it possible to keep the piston rod in the center of the cylinder. The piston of a comparatively new high-speed engine in the same plant contains three pieces, namely, the spider and two packing rings. If the joints in these rings remain at the bottom of the cylinder they do not leak steam. If they move around to the top, they leak, and there is nothing to prevent it. There is no way to center the piston rod, hence when the spider wears on the bottom the only remedy is to get a new piston.

When a dynamo is new the armature is concentric with reference to the field magnets. If the bearings wear until the armature is nearer the lower poles the attraction may cause excessive pressure on the lower halves of the bearings, causing them to heat without apparent cause. If a pasteboard air-gap gauge is used once a month, any excessive wear can be detected. Dynamos are usually fitted with a device by means of which the armature may be kept central.

Fig. 2 illustrates the cylinder of an engine that is fitted with an angle throttle valve, containing a smaller valve constituting a by-pass. This is convenient to use when warming the cylinder before starting up, as a little steam can thus be admitted and the resulting water will pass out through the drip pipes without starting the flywheel. It will also admit enough steam when wide open to run the engine at full speed with no load.

and it is intended for this purpose. Care should be taken, however, to open the main throttle valve before throwing on the load. While such a mistake may do no special harm, with only one dynamo in use, if another generator is already in full operation, and this one is to be run in parallel with it, trouble will result. In paralleling dynamos, one being in operation, the second is brought up to speed and its voltage made equal to, or slightly higher than that of the other. All this may be done with only the by-pass open, but when the full load is thrown on, it will not supply enough steam to maintain full speed, hence as soon as it becomes less than the standard the voltage drops allowing energy to pass over from the first machine and drive the second as a motor, unless it is properly protected.

Sometimes it is impossible to secure full voltage on a compound-wound dynamo until a partial load is put on amounting to, say, 25 per cent of the full load. This is often inconvenient with only one engine in service, as but a few lamps may be required at times, although full voltage is wanted for them.

In one case this objection was overcome by increasing the tension on the helical spring shown in Fig. 3. Three revolutions on the large screw which holds it gave a speed resulting in an increase of five volts, thus securing the required e. m. f. This plan is recommended where it is desired to allow the brush holder to remain stationary.

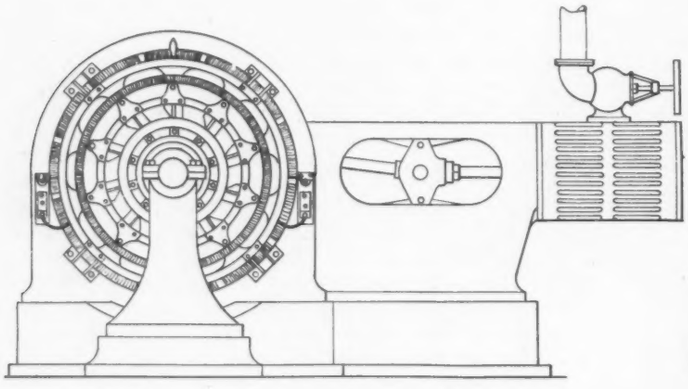
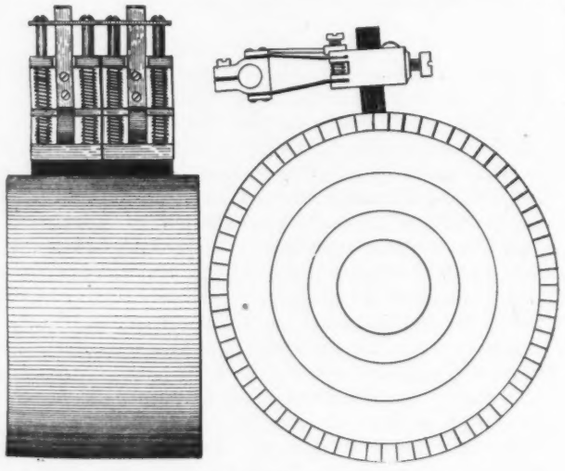


FIG. 4.—DIRECT-CONNECTED GENERATOR.



FIGS. 5 AND 6.—BRUSH HOLDERS.

Oftentimes the substitution of new brushes will cause a dynamo to spark and heat badly where such was not the case before. In one instance this was cured by moving the brush holder shown in Fig. 4 in the direction in which the engine ran. As this is a 10-pole machine with peculiar brush holders having a special brush, it required several hours to change the brushes and when the new ones were unsatisfactory and the movement of the brush holder as above described proved a remedy for the trouble it was a source of much satisfaction; although there was no apparent reason for the difference in results.

In another case shifting of the brush holders made no difference in the behavior of the brushes, as they continued to spark and heat badly until removed, but the next set used was entirely satisfactory. The plan illustrated in Fig. 1 for cooling a warm bearing proved valuable in keeping the commutator cool enough to complete the run, thus preventing the chagrin and annoyance of a shut-down during working hours. The principal cause of sparking in the writer's experience has been chattering brushes. This does not mean that the defect was bad enough to attract special attention, but the brushes failed to remain steadily on the commutator, and whenever the contact was not perfect sparking resulted.

Brush holders may be classed under two heads, those that are given a certain tension by the makers which cannot be changed without substituting new parts, and those whose tension can be varied by the engineer. The former is illustrated in Fig. 5, which shows two brushes that are held in contact with the commutator by helical springs. While it is possible to change the tension of these holders by the substitution of other springs or something similar, the fact that they are made in this form does not encourage the engineer to make a change, as it is evident that the makers consider this the best tension for general service, and it is generally assumed that they have practical knowledge on the subject.

Fig. 6 illustrates the adjustable brush holder, and it is only necessary to loosen a binding screw in order to give the holder more tension; then by tightening the same screw the brush is held firmly in place. The lightest tension that will prevent chattering is best, because it wears the commutator less.

Application of commutator compounds or lubricants may prevent further sparking of a dynamo, but the writer has seen the potential drop 15 volts as soon as a certain compound was put on the commutator, because the thin film of compound increased the resistance between the brushes and commutator. Too much of any compound is detrimental to good service, as it collects on the commutator bars and causes chattering of the brushes where only a light tension is used. This can be removed with sandpaper, but if some of the compound is needed, a few drops of kerosene oil carefully applied will soften it and make it less troublesome.

When stopping the dynamo in the plant with which the writer is connected, the switches are pulled out before steam is shut off from the direct-connected engine, or the clutch is thrown out on the belted dynamo, consequently when started the next day the dynamos always generate electricity readily. While visiting another plant where electricity is used the writer noticed that the engineer did not disturb the switches when it was time to shut down, but simply stopped the engine, allowing the lamps to grow dim and finally become extinguished as the armature ceased to revolve. All switches were in when this plant was left for the night.

This does not necessarily mean that the switches ought to be left in at all times, but, on the contrary, the fact that this dynamo frequently fails to generate when it is started in the morning shows that something is wrong with the machine or else it is improperly used. By using a piece of insulated copper wire, removing the insulation from both ends of it, and holding one end on a positive brush and the other on a negative the machine may be made to pick up.

Dynamos in small plants should ordinarily be covered with a waterproof cloth or rubber blanket at night to protect them from dampness. If a dynamo is accidentally wet it may generally by dried by running it at full speed for some time without load.

Inside the frame of a dynamo seems to be a favorite place for some engineers to keep waste, but this is a bad and dangerous practice, because any dynamo or motor is liable to throw down sparks that will ignite this and cause the machine to be scorched or burned before the fire is discovered.

LETTERS ON PRACTICAL SUBJECTS.

SOME ENGINE-ROOM PIPING.

"How not to do it" seems to be of fully as much importance as "how to do it," judging by some piping recently overhauled in an engine room; a few lessons in the laying-out of pipe connections were badly needed. In one instance, a trap had been installed to take the drip from a large heating coil. The arrangement was as shown by Fig. 1, with the exception of the unions *a* and *b*, which were left out of the original arrangement,

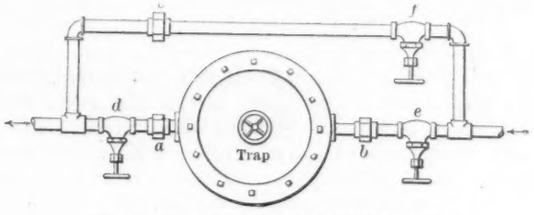


FIG. 1.—CLOGGED BY-PASS CONNECTIONS.

but which had been put in by the engineer. Without the unions in question, it is impossible to disconnect the trap without taking down a lot of piping, and if anything went wrong with either of the valves, it was also necessary to take down the piping to get at the defective valve. The valve *d* was also conspicuous by its absence when the job was originally piped, the valve *e* being closed when it was desired to use the by-pass instead of the trap.

One day something went wrong with the trap and the engineer attempted to open it for inspection. The drip was turned into the by-pass, but with little effect, for as soon as the cover was removed from the trap, out came steam and water which backed up from the outlet pipe. It was found necessary to close down the entire heating system before the trap could be adjusted, so badly did the steam and water blow back into the discharge. The valve *d* was then cut into the piping and the unions *a* and *b* were added to permit the trap to be removed bodily when desired, without interrupting the flow of condensed water from the heating coils.

At another time the engineer opened the by-pass to cut out the trap for inspection, but the by-pass wouldn't pass, and again the steam coil had to be shut down to the great discomfort of everybody in the building. Inspection revealed the fact that the constant flow of water past the by-pass openings had deposited some dirt in those pipe openings and the dirt had become so baked and hardened that not a drop of water or steam could

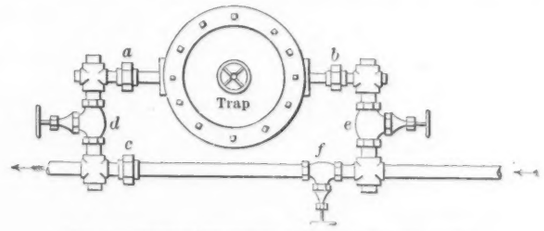


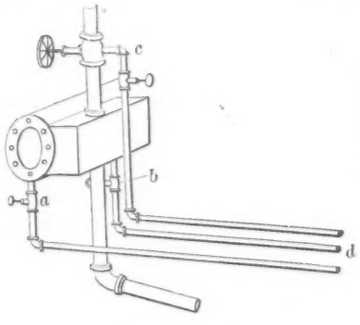
FIG. 2.—RECONSTRUCTED BY-PASS CONNECTIONS.

get through the by-pass pipes. At the very first opportunity the engineer took down the trap connections and replaced them as shown in Fig. 2. In this arrangement the trap is virtually in the by-pass, while the actual by-pass is through the straight pipe connection containing valve *f* and union *c*. The engravings show the arrangement so plainly that little description is necessary, save to note that the elbows employed in the by-pass connections, as shown in Fig. 1, have been replaced in Fig. 2 by crosses and plugs, thus permitting the pipes to be opened and a wire introduced for removing any deposit which may become lodged in the pipes. It is practically impossible to clog this piping, as the arrangement is such that a rod or wire may be run into any pipe in the system, and by removing the bonnets of the valves, every inch of the connections may be cleaned.

In the same engine room it was noted that the drip from the cylinder of a small engine had been piped in a very neat and pleasing manner, and upon remarking the fact to the engineer, he remarked with a smile that it certainly was an improvement over the piping in use when he took charge of the plant. The engineer then drew a sketch to show the original arrangement of the drips from the engine. This lay-out, as shown by Fig. 3, consisted of three single pipes, each fitted with a valve, and terminating on the floor just above the mouth of an open drain into which the water found its way.

The condition of things around the mouth of that drain could well be imagined when the valve was opened to drain the steam pipe from just above the throttle valve. A few gallons of water, some steam and a little grease from the lubricator diffused itself over that portion of the engine room adjacent to the sewer opening.

The new drip connections were all brought together and tapped into the exhaust pipe as shown by Fig. 4. In addition to the valves *a*, *b* and *c*, as shown by Fig. 3, three unions were placed as shown by Fig. 4 at *d*, *e* and *f*. By means of the tees *g* and *h*, the three drip pipes were brought into the pipe from the throttle, which in turn was screwed into the exhaust pipe, thus making tight connections and a clean job.



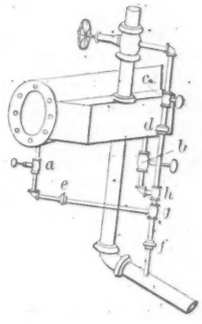


FIG. 3.—UNDESIRABLE DRIP PIPING. FIG. 4.—GOOD DRIP CONNECTIONS.

The only criticism ever offered to this method of engine-drip piping, at least in the hearing of the writer, was by one engineer who wanted to see the end of the drip pipe when he opened the drip valves, in order that he might see what came out of the drips. The engineer of the plant replied that he could always tell by the sound, when steam was blowing through the pipes, and that he knew enough to shut the valves without peeping into the pipes.

NEW YORK CITY. JAMES FRANCIS.

AN OPPORTUNITY FOR INVENTION.

There is a chance for the inventive man to work up an electrical oiling device which will relegate to obscurity many of the elaborate oiling systems in use at the present time. The principle upon which the device is to operate is very simple and requires little machinery for its application to almost any bearing. Bearings are acknowledged to run to the best advantage when supplied regularly with a certain amount of oil fresh from the source of supply. The flooded method of oiling has its advantages, and, where it can be applied, leaves little to be desired, but it cannot be used for exposed bearings the surroundings of which must be kept clean.

The principle upon which the new oiler is to work is as follows: A tube filled with oil is heated and the expansion causes some of the oil to pass into the bearing. The heating of the oil in the tube is to be done by means of a wire or a coil of wire suspended in the oil, a current of electricity sent periodially through the wire, furnishing the heating power. The application of electricity is to be continued until the required volume of oil has passed over into the bearing. After the circuit

is opened, the cooling of the oil tube by the atmosphere causes the oil contained therein to contract and another portion of oil is drawn into the tube, which is then ready for another heating from the enclosed wire.

The time of heating and cooling can be determined by a revolving commutator which carries a contact for each bearing, or for each group of bearings found to require the same amount of electricity. The entrance and exit of oil might be governed, in the tube, by slight clapper valves, or by metal disc valves, according to the kind of oil handled. The writer is not aware of any patents covering such a device and gives the idea to the public for whatever it is worth.

Scranton, Pa. John Scott.

MODERN STEAM ENGINES FOR ELECTRICAL SERVICE.

The successful steam engineer must keep in touch with the continual change and progression in the field of prime movers for driving electric generators. Steam turbines are already dangerous rivals of the large multiple-cylinder, reciprocating engines until quite recently so common in large power stations. In fact turbines have almost crowded this type of reciprocating engine out of the market.

Producer gas engines are clamoring loudly for proper, and doubtless, entitled recognition, and yet with it all, the thoroughly "up to date" reciprocating type of engine for medium and high speeds for direct connection to generators, especially in sizes ranging from 100 to 500 kilowatts, undoubtedly retains its prestige, and equals both the turbine and the gas engine for particular kinds of service.

The vital characteristic requirements of a prime mover for isolated electric lighting and power plants, can be grouped under the following half hozen headings in the order of importance named:

1. Reliability: Uninterrupted service of the engine is paramount and is obtained as the direct and logical result of correct design, the very best material and workmanship throughout, intelligently proportioned bearings and wearing surfaces, and a simple method of positive, continuous automatic lubrication free from trappy and uncertain devices.

2. Economy: This is obtained only by the happy combination of several elements, embracing correct design and construction, perfect regulation, the use of improved speeds, steam-tight valves and pistons, multiple steam ports, permitting rapid and properly timed steam admission and free exhaust, and the economical use of steam at variable loads, especially the underload, a condition which often prevails in an isolated plant, In addition to this, the engine must be designed for a system of positive automatic lubrication, which permits copious oil circulation through the bearings and pins, and consequent elimination of frictional losses.

3. Quiet Running: As evidenced by the many glaring failures this is a feature exceedingly difficult to accomplish, and the engine must be especially designed for such service, the greatest of care being given to a correct governing device, perfect balancing throughout, and the valve gear constructions, which, while without complications, will meet the peculiar demands of extreme load variations. The main shaft and crank construction must ensure the preservation of the original perfect alignment, which has led to the almost universal rejection of the center-crank multiple bearing design, in favor of the side-crank two-bearing construction to ensure quiet running after the engine has been in service for any length of time.

4. Compactness: The accomplishment of this necessarily demands medium or high speeds, thus permitting moderately short strokes, thereby reducing the overall dimensions, and resulting not only in a saving of valuable floor space, but effecting as well a large saving in the cost of foundations and of the building, and a saving of labor of the attendant.

5. Cleanliness: The reciprocating parts must be enclosed and protected wherever practicable, but without the sacrifice of convenience of operation and thorough accessibility to the working parts; then, too, the elimination of a score or more of sight-feed oil cups, which require frequent attention and adjustment by the operator, has made it possible for the engine to be arranged so as to make it almost entirely free from the common fault of "oil slinging."

6. First Cost: Cheap offerings will always attract a certain class of inexperienced buyers and thereby frequently prohibiting attainment of their best interests by limiting the price, at which really competent builders are forced to withdraw from competition, and a trifling sum is saved in the first cost at a disastrous ultimate cost, almost sure to result in expensive repairs sooner or later, coupled with interrupted service and consequent serious loss thereby, as well as extravagant waste of steam; many such installations are in evidence as a warning against buying "too cheap."

Chicago, Ill. A. M. Morse.

VACUUM CLEANING APPARATUS IN THE POWER HOUSE.

A vacuum cleaning outfit should be made a part of the equipment of every power station, steam plant and factory. There is hardly an operation so destructive to machinery as the ordinary process of removing dirt by sweeping. It is to the use of vacuum cleaning in the power house that these lines are particularly directed. For many years, the wood worker has recognized the value of vacuum cleaning, and his shops have all been equipped with vacuum systems for removing shavings, sawdust and other refuse from the various machines. But the wood worker has continued to use the vacuum cleaning system in its crudest and mose rudimentary form.

In the power house it is dust which causes most of the wear to machinery bearings, and it is dust which causes much damage to generators and other appliances. In his efforts to counteract the effects of dust, the station man spends hours with bellows and brush, carefully blowing the dust deposited out of generators, motors and switchboards, and he has spent other hours cleaning lamp mechanisms and instruments.

With a brush fitted to a perforated hollow handle to which the vacuum hose is connected, dust troubles would vanish like magic and dust itself would cease to be a station bug-a-boo. The vacuum floor broom takes up every speck of dust from the floor, wall or ceiling, and in central stations that appliance should be a part of the regular equipment.

How many engine pulleys are to be found plentifully coated inside with dust which is suffered to remain undisturbed because the engineer does not wish to subject the entire power house to a coating of dust particles. See the coating of many varieties of refuse material inside of the other pulleys and note the deposits on and above every electric wire. Especially when carried close to a wall or ceiling, wires seem to cause a heavy deposit of dust upon the adjacent surface.

Vacuum cleaning apparatus is not expensive to install. Its cost is little and its efficiency is great. About all that is necessary is the exhaust blower, the hose, the dirt-settling chamber and the brush or cleaner by means of which the dust is gathered and directed into the hose.

Boston, Mass. John Jackson.

TESTING WATT-HOUR METERS.

Every electric light and power company should have a department for testing watt-hour meters, the benefit derived from the careful handling of a meter system warranting the necessary expenditure to obtain the required equipment.

The testing department should be located in a place as dry and free from vibration as possible.

As watt-hour meters are expected to operate under varying conditions, when installed, this should be taken into consideration when selecting a location for a testing board, and an effort should be made to establish conditions as near as possible to those under which the meter is to operate. If vibration is excessive, the meter may be suspended, or it may be placed on an air cushion, which will tend to neutralize the vibration. To this testing board should be connected potential leads from the system. When the line voltage fluctuates, storage batteries are used.

The bank of lamps to be used should be arranged so as to

permit any desired load to be easily applied. For extra heavy loads, a water rheostat is very convenient.

To obtain the best results a suitable equipment of instruments is essential. For alternating-current work an indicating wattmeter is always to be preferred. Two instruments should be provided, one to check the watt-hour meter at full-load, and the other to check the meter at light load with sufficient degree of accuracy. The use of this small range instrument avoids observation errors when reading an instrument at the lower end of the scale.

For direct-current work, a portable ammeter and voltmeter are required. In addition, a reliable stop-watch is essential for taking the speed. Too much care cannot be used in the

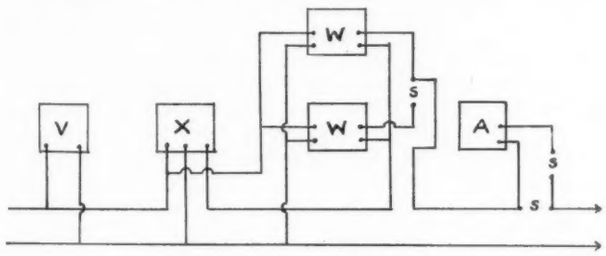


FIG. 1.—METER CONNECTIONS.

handling of these watches, and in checking them with some standard. In doing this it is advisable to check them at different points of the dial.

In order to insure accuracy independent of the change of room temperature, it is necessary that the temperature resistance coefficient of the materials of the disc and that of the potential or shunt circuit, should be the same. For this reason a watt-hour meter should be connected to the circuit for about 20 minutes before any test is made. In testing meters a mark should be made on the outer edge of the disc, in order that the time required to make a certain number of revolutions of the disc may be noted. The following formula is used for testing General Electric watt-hour meters $(3600 \times K \times R) \div S = W$, in which R is the number of revolutions, S the number of seconds required to make this number of revolutions; K, the calibrating constant marked on dial face of non-direct reading meters and on the disc of direct-reading watt-hour meters; 3600, is the number of seconds in an hour.

The number of revolutions should be such that the time of observation will be from 30 to 60 seconds. If materially less than 30 seconds, errors in the measurement of time are probable, and observations of longer than 60 seconds are generally unnecessary.

Whatever instrument may be used, the tester should be particularly cautioned not to allow the instrument to indicate the loss in the potential circuit, as this will cause an error of appreciable magnitude in light-load operation.

Fig. 1 shows the wiring of the instruments to the testing board, which should be closely followed in testing General Electric instruments. The upper wattmeter has a range of 25 amperes and the lower one has a range of 5 amperes. The watt-hour meter under test is represented at X. For direct-current measurements, the voltmeter and ammeter, or the indicating wattmeter, should be used,, and for alternating-current measurements the wattmeter and voltmeter.

Three-wire watt-hour meters can readily be tested as a two-wire meter by connecting the two current coils in series and using the instruments as shown in Fig. 1. For two-wire circuits, the calibrating constant K must then be divided by two. For a three-wire meter two sets of instruments are necessary, the calibrating constant used being found marked on the disc.

In testing polyphase watt-hour meters it is easier to check the instrument as a single-phase meter by connecting the current coils in series and the potential coils in parallel, and dividing the constant by two. To check either side separately connect one potential circuit only at a time and use the constant as marked on the disc.

When it becomes necessary to change the frequency, the central station manager will find it to his advantage to have the meters arranged by the manufacturer or by an expert who thoroughly understands the theory and operation of the meter, for should these duties be left to an inexperienced person very unsatisfactory results will be obtained.

The writer can recall an experience he had a few years ago while out changing a number of instruments that had been adjusted by an inexperienced person. These were found to be 8 per cent slow, although they had been tested by the city inspector. This meant a direct loss sufficient in amount to warrant the necessary expenditure to obtain the services of an expert.

An expert will make a report on each instrument that will show its exact condition under various loads, and, as a rule, will leave a chart for the tester that will show the number of seconds required to make a required number of revolutions under various loads, which will enable the tester to keep the meters up to the standard. The formulas used with various makes of watt-hour meters are as given below. For Westinghouse type "A," single-phase, two-wire watt-hour meters used without transformers, watts $= (R \times K) \div S$. In this formula K equals volts times amperes, as marked on the counter, multiplied by 1.2. For example, a 5-ampere, 100-volt meter will have a value of K equal to $5 \times 100 \times 1.2$, or 600. For meters used with series transformers, but checked without them, K equals the volts marked in counter multiplied by 6. In checking watt-hour meters that are used with potential and series transformers without the transformers, K equals 600. When testing the Westinghouse single-phase, three-wire meter K equals volts times amperes as marked on the counter times 2.4. Type "C" single-phase, three-wire meter may be checked by the same formula.

Fort Wayne watt-hour meters are checked by the following formula: $(R \times 100 \times K) \div S = watts$. The value of K will be found marked on the cup.

Gutmann, or Sangamo Electric Company, meters are tested by the formula: $(watts\ indicated \times S \times train\ ratio) \div 3600 = R$ $(K \times R) \div S = watts$; in which K equals the watt-seconds per revolution for the type of meter under test (marked on each instrument by a label), and is equal to the watts-seconds per revolution of the disc. Thus, a 5-ampere, 100-volt meter will have a train ratio of 4. and its disc makes four revolutions for every watt-hour it records, or it will make ten revolutions in 18 seconds, with a load of 500 watts.

Duncan meters may be checked by the formula, $(R \times 3600 \times K) \div S = watts$. K is equal to the value marked on the disc.

For alternating-current instruments, connect as shown in Fig. 1. If it is desired to use the upper indicating wattmeter open the single-pole switch, and when using the lower instrument close the single-pole switch. By connecting a rheostat

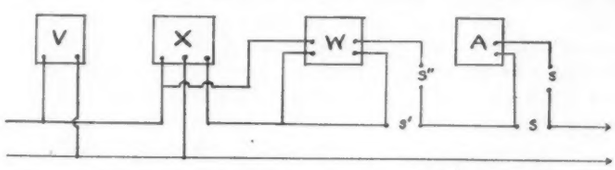


FIG. 2.—ARRANGEMENT FOR DIRECT-CURRENT METERS.

in series with the lower bus a constant potential can be maintained. For direct-current meter the connections are made as shown in Fig. 2, switches being provided for cutting out instruments.

Example: Given a 10-ampere, 110-volt meter with a testing constant K of one-half that makes 20 revolutions in 60 seconds with a load on the indicating wattmeter of 600 watts, by applying the formula we find $(20 \times 3600 \times \frac{1}{2}) \div 60 = 600$ watts, showing that the meter under test records correctly; but should the disc have made only 19 revolutions in 60 seconds, then the watts would be $(19 \times 3600 \times \frac{1}{2}) \div 60 = 570$ watts, and the meter is 5 per cent slow.

DULUTH, MINN. FRED DUBELL.

MORE ABOUT AN INTERESTING PROBLEM.

Since the publication in the December issue of the ELECTRICAL WORLD of the letter, "An Interesting Problem," the writer has received several letters from engineers who would like further particulars concerning the conditions to be met in redesigning the Willoughby, Ohio, municipal electric light plant and pumping station. To begin with, all communications relating to the proposed changes in this plant should be addressed to Mr. Sam Low, chairman of the Board of Public Service, Willoughby, Lake County, Ohio. All questions, either engineering or financial, should be taken up with that gentleman, direct, instead of through the writer.

Additional data are as follows: The pumping station is located about 10 ft. above a low-water source of water supply and a dam 4 ft. or 5 ft. raises the supply surface of the water that amount, so that there is never more than 6 ft. or 7 ft. draft to the pumps, even when the filter tunnel is empty, or nearly empty. The filter tunnel is about 100 ft. long and runs parallel with the east branch of the Chagrin River, and water intended for the pumps must seep through the gravel between the river and the tunnel—something very readily accomplished 15 years ago when the tunnel was first built.

But lately the gravel bank of the river seems to have become pretty thoroughly impregnated with silt, and when the water is high, just after a storm, the filter bank will not let through enough water to supply the pump, so that an intake has to be opened directly into the river. Then, the water in town resembles that at the junction of the Mississippi and Missouri Rivers. The East Branch rises a very few miles away in a pretty hilly country, and it jumps up several feet in a very few hours after a rain at its source, hence the silt question is a very serious one. When the water recedes after one of the little freshets, every bit of shale rock along the bed of the river, and every bit of driftwood, and even the gravel bed of the river itself, is covered with a silt deposit from ⅛ in. to ¼ in. thick.

A 12-in. main runs from the tunnel filter to the pump, and a 12-in. main leads from the pump to the reservoir, about a half mile distant, and about 180 ft. above the level of the pumps. The pumping station is at the foot of a bluff 100 ft. high, a line from the top of the bluff to the coal bunkers falling to an angle of about 45 deg. At least, that seems to be about the angle of the present steel coal chute which leads from the highway on top of the bluff to the coal bunkers of the power house.

The 12-in. water main leading to the village intersects, near the top edge of the bluff, the 12-in. main leading from the pumping station to the reservoir, and a valve placed at that point in the pipe leading to the reservoir on the side of the pipe junction next to the reservoir permits the system to be made at will to act upon the Holly principle by closing the valve in the reservoir main, above mentioned. The pressure in the village, due to static head of water in the reservoir, is now about 56 lbs. gauge, and by closing the reservoir valve there is readily given all the fire pressure necessary to throw water direct from hydrant attached hose over the highest buildings in the village. With but very little assistance from the Holly principle, water can be readily thrown entirely over every church steeple in the village.

The present pump is a 10-in. duplex, and at least double its capacity in water will be required upon completion of the sewer system now being installed and which will be completed within two years. The natural increase in consumption due to population growth must also be allowed for, and a 12-in. pump which could be run 24 hours a day, if necessary, seems about right to fill the bill in place of the present 10-in. pump, which cannot be run more than eight hours a day in winter, at full power, and 12 to 14 hours at partial capacity. In summer, the pump can run about 14 hours at full capacity, and about four hours at partial capacity.

The reason for this queer and somewhat complex arrangement of possible running hours lies in the fact that the boilers which operate the water pump must also be used to drive the electric generators, of which at present there are two—one alternating current, supplying the incandescent lamps, and the other generator delivering direct current to the arcs, of which, at this writing, there are about 27 burning, while at least 40 should be in use. These lamps are switched into circuit at dark and run until 12 o'clock, midnight. The incandescents are turned on at dark each afternoon, and run until turned off by users, say, 10 o'clock to 12 o'clock each night. There are also a number of incandescent street lamps, which burn from dark to daylight, all night and every night.

The station is supplied from a natural gas well with about one-half enough fuel to run the plant, and, in addition to the gas, the boilers use about three tons of coal a day, pretty steadily the year around, there being more light and less water in winter, and more water and less light in summer.

The present need of the people seems to be the replacing of the present equipment entirely by a plant of modern efficiency, and radically different from what is now in use. The present static pressure of gas in the well is about 25 lbs. to the sq. in. and the well has only decreased a little more than one-half its flow in 16 years. It is stated that the well was not properly driven in the beginning. It has been demonstrated that anywhere in Lake County gas can be obtained by sinking a well 700 ft. at a cost of 50 cents a foot. It has also been demonstrated that after a well weakens in its flow, another well may be driven only a short distance, say, 100 ft. or more from the failing well, and a full force and flow of gas secured from the new well. This can be repeated indefinitely.

It seems as though the solution of this interesting problem, for a reasonable amount of money, would be to put in new and larger filter tunnels along the river bank, giving plenty of surface so that none of the tunnels need be overworked when high water, which means dirty water, is at hand. The old tunnel, 15 or 16 years in use, now probably passes one-third or one-half the amount of water taken by the pump, and a larger outfit of filter tunnels would answer for another dozen years undoubtedly.

As for the electrical plant, that should be modernized, and generators of 85 per cent to 95 per cent efficiency substituted for the present outfit of only 45 per cent to 50 per cent efficiency. There should also be a rearrangement of the system whereby a higher voltage than 110 volts could be used, and a rearrangement of the arc and incandescent circuits so as to simplify the present arrangement.

The power plant should be completely reorganized, the boilers and engines discarded, and gas engines installed instead. A system of wells should be driven as found necessary along the valley for a mile or more, and each casing properly packed at the ledge found just above the oil-bearing strata, the packing being done in such a manner that there will be no loss of gas in the upper strata; as wells are now arranged in this vicinity there is doubtless a loss of 50 per cent to 75 per cent of the gas in the upper and porous strata.

A gas engine should be installed for each machine, or pair of machines, as the best engineering practice may decide after a thorough study of the matter. There is gas enough now taken from the single old well at the plant to drive all the machinery if the gas be used in an internal combustion engine instead of being burned under a boiler as at present. With a line of wells down the valley, and a judicious use of each from time to time, shutting off some and cutting in other wells, there will be no lack of gas for 15 or 20 years to come—judging from the behavior of the wells in Lake County for the past 15 years.

With the exceedingly flexible gas engine arrangement, a single pump can be used to work 24 hours a day, instead of as at present, having to be shut down when the electric load is large. At present, should a large fire occur at night, it would be necessary to cut out all, or a large part, of the electric lamps in order to cut in the Holley system of water supply for fire purposes.

A 24-hour service through a 12-in. main will supply a good deal of water under a 50-lb. to 60-lb. pressure, and a continuous service pump, even with the present pump held as a reserve, will prove ample for time to come until the village has outgrown a 12-in. main. When this has to be duplicated, the pump

should also be duplicated, and mains and pumps put in suitable for the new needs, holding the present proposed improvements as a reserve for another 20 years. The situation is such that the tunnel filter system can be extended indefinitely, and the population in the East Branch Valley is such that no case of typhoid has yet been traced to the water supply, and probably will not for 15 years to come. After that period, germ filtering may be found necessary instead of gravel-tunnel methods as at present.

To recapitulate, the present solution of this very interesting problem seems to be:

1. Building new and larger filter tunnels similar to the present one.
2. Putting in a 12-in. pump, gas-engine driven.
3. Putting in a new electric generating outfit, also gas-engine driven and independent of the pump.
4. Sinking new gas wells, as required, as units of a well-designed system.
5. Holding the present plant in reserve until the gas-driven machines shall be duplicated.
6. Designing the new plant so that a producer-gas plant may be added easily when natural gas eventually fails.
7. Take the plant out of politics and place it in the hands of an efficient manager, who shall not be changed upon each election day, as at present.
8. Extend the present service, both of water and of electricity, and establish a day service and encourage the sale of energy for motors and for cooking and heating.

WILLOUGHBY, OHIO. JAMES F. HOBART.

CAUSES OF SMOKE.

In the report upon smoke abatement prepared by the Syracuse Chamber of Commerce is a short chapter devoted to the causes of smoke which should make interesting reading for your practical letters department, since that department has contained other interesting facts bearing on this subject contributed by various persons. The following abstracts from the report which was made by a committee made up for the most part of technical men, are worthy of careful attention in the boiler room of many central stations.

The amount and quality of smoke discharged from a chimney may vary all the way from a dense cloud of jet black smoke which may be carried by a light wind for a distance of a mile or more before it is finally dispersed into the atmosphere, to a thin cloud which becomes invisible a few feet from the chimney. Often the same chimney will for a few minutes after firing give a dense black cloud and then a few minutes later the smoke will have entirely disappeared.

The quantity and density of smoke emitted from a chimney depend upon many variable causes. Anthracite coal produces no smoke under any conditions of furnace. Semi-bituminous, containing 12.5 to 25 per cent of volatile matter in the combustible part of the coal, will give off more or less smoke, depending on the conditions under which it is burned, and bituminous coal, containing from 25 to 50 per cent of volatile matter, will give off great quantities of smoke with all of the usual old-style furnaces, even with skilful firing, and this smoke can only be prevented by the use of special devices, together with proper methods of firing the fuel and of admission of air.

Smoke may be prevented from forming if each particle of smoky gas, as it is made by distillation from coal, is immediately mixed thoroughly with hot air, and if smoke is formed by the absence of conditions for preventing it, it may afterwards be burned if it is thoroughly mixed with air at a sufficiently high temperature. The essential conditions for preventing smoke in boiler fires may be enumerated as follows: (1) The gases must be distilled from the coal at a uniform rate; (2) the gases, when distilled, must be brought into intimate mixture with sufficient hot air to burn them completely; (3) the mixing should be done in a fire-brick chamber; (4) the gases should not be allowed to touch the comparatively cold surfaces of the boiler until they are completely burned. This means that the gases shall have sufficient space and time in which to burn before they are allowed to come in contact with the boiler surface.

Every one of these four conditions is violated in the ordinary method of burning coal under a steam boiler. (1) The coal is fired intermittently and often in large quantities at a time, and the distillation proceeds at so rapid a rate that enough air cannot be introduced into the furnace to burn the gas. (2) The piling of fresh coal on the grate in itself chokes the air supply. (3) The roof of the furnace is the cold shell, or tubes of the boiler, instead of a fire-brick arch, as it should be, and the furnace is not of a sufficient size to allow the gases time and space in which to be thoroughly mixed with the air supply.

In order to obtain the conditions for preventing smoke it is necessary: (1) That the coal be delivered into the furnace in small quantities at a time. (2) That the draft be sufficient to carry enough air into the furnace to burn the gases as fast as they are distilled. (3) That the air itself be thoroughly heated by passing through a bed of white-hot coke or by passing through channels in hot brickwork, or by contact with hot fire-brick surfaces. (4) That the gas and the air be brought into the most complete and intimate mixture, so that each particle of carbon in the gas meets, before it escapes from the furnace, its necessary supply of air. (5) That the flame produced by the burning shall be completely extinguished by the burning of every particle of the carbon into invisible carbon dioxide.

If a white flame touches the surface of a boiler, it is apt to deposit soot and to produce smoke. A white flame itself is the visible evidence of incomplete combustion.

The first remedy for smoke is to obtain anthracite coal. If this is not commercially practicable, then obtain, if possible, coal with the smallest amount of volatile matter. Coal of from 15 to 25 per cent of volatile matter can easily be obtained and it makes much less smoke than coal containing higher percentages. Provide a proper furnace for burning coal. Any furnace is a proper furnace which secures the conditions named in the preceding paragraphs. Next, compel the firemen to follow instructions concerning the method of firing.

It is impossible with coal containing over 30 per cent of volatile matter and with a water-tube boiler, with tubes set close to the grate and vertical gas passages, as in an anthracite setting, to prevent smoke, even by the most skilful firing. This style of setting for a water-tube boiler should be absolutely condemned. A Dutch oven setting, or a longitudinal setting with fire-brick baffle walls is highly recommended as a smoke-preventing furnace, but with such a furnace it is necessary to use considerable skill in firing.

Mechanical mixing of the gases and the air by steam jets is sometimes successful in preventing smoke, but it is not a universal preventive, especially when the coal is very high in volatile matter; when the firing is done unskilfully, or when the boiler is being driven beyond its normal capacity. It is essential to have sufficient draft to burn the coal properly and this draft may be obtained either from a chimney or a fan. There is no especial merit in forced draft, except that it enables a larger quantity of coal to be burned and the boiler to be driven harder in case of emergency, and usually the harder the boiler is driven the more difficult it is to suppress smoke.

Down-draft furnaces and mechanical stokers of many different kinds are successfully used for smoke prevention, and when properly designed and installed and handled skilfully, and usually at a rate not beyond that for which they are designed, prevent all smoke. If these appliances are found giving smoke, it is always due either to over-driving or to unskilful handling. It is necessary, however, that the design of these stokers be suited to the quality of the coal and the quantity to be burned, and great care should be taken to provide sufficient size of furnace with a fire-brick roof and means of introducing air to make it completely successful.

SYRACUSE, N. Y. B. K. TUTTLE.

QUESTIONS AND ANSWERS.

Can a 125-cycle generator be caused to give a 60-cycle current? We have a 90-kw, 1100-volt alternator and would like to change it to a 60-cycle machine, if possible. C. L. CO.

If the alternator be run at half speed, it will give a 60-cycle current, but the output will be only 45 kilowatts. It would be best to sell the alternator and purchase a 60-cycle machine.

What effect has the power-factor of a circuit upon automatic motor starters? G. J. J.

None. The solenoid depends for its strength upon the ampere-turns, and as long as the current is not changed, its operation is not affected by any change in the power-factor of the circuit.

Is it possible to hurry the charge of a battery? If so, how is it done? H. C. G.

If, in case of emergency, it is desired to charge a storage battery more quickly than usual, or in other words to hurry the charge, the early part of the charge should be given with extra high current; the completion of the charge being accomplished at the low final rate, the same as in normal charging.

The polyphase meter attached to our motor circuit runs sometimes in one direction and sometimes in another. Why should the meter behave in this manner? O. K. C.

The potential circuits are doubtless incorrectly connected. Disconnect the motor and use instead a bank of lamps as a load. Then open one potential circuit at a time and note if the meter runs forward. Should the meter run backward reverse either or both potential leads as the case might be. It is possible on a three-phase circuit of very low power factor for a single-phase meter to run backward even when connected correctly.

It is desired to ring four bells from three single push buttons as follows: Push button No. 1 to ring bell No. 1; push button No. 2 to ring bells No. 2 and No. 3, and push button No. 3 to ring all four bells at once. No switches other than the three single push buttons are to be used. How may this be done? B. R.

It is not possible to ring the bells in the combination stated if only single push buttons are used. The bells may be rung as desired by using a single push button to ring all the bells at once, and by using double-contact buttons for the other two combinations; the springs normally resting on the contact should be connected to the wire from the single push button circuit.

Electrical energy for lamps and motors is supplied from a three-phase turbo-alternator. The motor circuits are three-wire and the lamp circuits two-wire. The lamps are in circuit all the time and the three-phase motors are used only as required. The motors being fed from three busbars and the lamps from two, why should this not result in an unbalancing of the load on the alternator? H. M. S.

If synchronous motors are used the load will be almost balanced, as a synchronous motor would have a tendency to take all of its energy from the unloaded phases. With induction motors the same tendency exists, only to a lesser extent, and the usual practice is to install a voltage regulator on the lighting circuit, the motors looking after themselves. Any unbalancing is only slight at most, and induction motors never give trouble from this cause.

Kindly give answers to the following questions: (1) A conductor is charged to a potential difference of 200,000 volts by one-fifth of a coulomb. What is its capacity in microfarads? (2) What is the impedance of a 6 m. f. condenser on a 60-cycle, 2000-volt circuit, and how much current does it receive? (3) What advantage do paper-insulated cables possess over rubber-insulated cables and those having other forms of insulation? H. C. McI.

A condenser of capacity C assumes a charge of C coulombs under a continuous e. m. f. of 1 volt. When the e. m. f. is E volts, the charge will be EC coulombs. When the e. m. f. is 200,000 volts, the charge will be $200{,}000C$ coulombs. As stated by you the charge is one-fifth of a coulomb; hence $200{,}000C = 0.2$, whence $C = 0.1 \div 100{,}000$ farads, or 1 microfarad. (2) Impedance $= 1 \div (2\pi fC) = 1 \div (2 \times 3.1416 \times 60 \times C) = 1 \div 377C = (1 \times 1{,}000{,}000) \div (377 \times 6) = 447$ ohms. $I = (E \div X_c) = 2000 \div 447 = 4.524$ amperes. (3) The paper-insulated cable has less specific inductive capacity and hence less coulombs for charging and less shunted condensive impedance.

Some time ago you published instructions for painting electric signs so as to keep them always white. We have tried your suggestion with excellent results. If you can suggest some way of preventing the paint from peeling you will render a great service to the industry. J. T. C.

It is a difficult matter to get paint to stay on galvanized iron for any length of time. This is attributed by some to the greasy nature of the surface and it has been suggested that if the surface be treated with an alkaline wash the paint will stick. We question the efficacy of this treatment, however, in preventing the paint from peeling. Paint will not ordinarily adhere to metals and some metals are worse in this respect than others. Try corroding the metal slightly with copper sulphate in solution slightly acidulated with nitric acid. Wash off in an hour or two and permit the surface to dry, after which apply the paint. A first coat of red lead paint is said to adhere well to galvanized metal thus treated.

How may rotary converters be operated in parallel to supply a direct-current load? P. V. T.

Where several rotary converters are to feed the same direct-current system they may be connected in parallel just like shunt or compound-wound direct-current generators. With compound-wound converters an equalizing connection is made between the different machines. The load will be divided among the converters according to their direct-current voltages as in the case of direct-current generators. The voltage may be regulated by changing the alternating-current voltage. Slight changes may be made in the voltage by regulating the field current or by shifting the direct-current brushes. If the rotory converter under load has a strong series field, it may be necessary to short-circuit the series coils when throwing another rotary in parallel with it. The machine thrown into circuit has its field strengthened by dividing up the load and the other rotary has its field weakened, thereby causing the flow of heavy currents between the machines. This extra current is liable to cause disturbance which may reverse the polarity of the rotary carrying the load as well as to cause a heavy rush of current in the alternating-current feeder circuits. The rotaries thus paralleled should not receive energy from the same transformer secondaries.

Kindly publish directions for making a dry battery. J. S. S.

An inexpensive and yet withal a very serviceable dry battery may be made as follows: Fit snugly inside a zinc cup a tube of blotting paper. Pour into the bottom of the cup about two tablespoonfuls of hot melted pitch or rosin to insulate the bottom. Dissolve 5 ozs. of sal ammoniac in one pint of water and add about 7 ozs. of granulated chloride of zinc. Stir the mixture until all is dissolved and continue stirring every few mintes for one-half hour or more. The solution is then ready for use. Soak the blotting paper inside the cup thoroughly with the solution by filling the cup about three-quarters full and allowing it to stand for a few minutes. Pour out the solution and place a carbon plate in the center of the cup; about it pack a depolarizing mixture of 8 ozs. of powdered black oxide of manganese and 16 ozs. of powdered carbon which has been previously moistened with about 5 ozs. of the solution. The packing will probably force a little of the solution up the paper by compression; but will not injure the cell any. When the powdered elements are wet enough, clean away all particles of the carbon element from the top of the paper and zinc cup so that there will be no internal short circuit. The cup may then be sealed with pitch or rosin and when connections have been made to the zinc and carbon, the cell is ready for use.

The Central Station Inquiry Department.

BY JOHN G. LEARNED.

During the past few years, so much has been said regarding the various methods of securing new business, that one is greatly surprised at the lack of expression relative to the proper handling and retaining of customers. Perhaps this is due to the fact that central station managers are too busy getting new customers. It is generally conceded that a satisfied customer is the best advertisement that the central station can secure. A great question seems to be "How to obtain and maintain friendly relations with that portion of the public secured as customers."

Assuming that the central station management is offering reasonable rates, and that the service is good; one naturally concludes that complaints and dissatisfaction would be entirely eliminated. Contrary to this, experience has taught that complaints are sure to come in, especially in the fall and winter season of the year. As one central station manager said: "As the days become shorter, our troubles become greater." Most companies maintain a complaint or claim department, even though it be a one-man department, and that man often a combination general manager, superintendent and contract agent. The customer with a grievance, has it intensified and magnified when he encounters a complaint department, because it so thoroughly fits in with his own ideas. Therefore, let us ease off the first meeting by establishing an "inquiry department." It is an innovation, which, practiced by the writer who is contract agent of the North Shore Electric Company of Chicago, works exceptionally well. This department takes the complaining customer off his guard and teaches him that the company does not solicit or recognize complaints. The writer will treat of methods of handling inquiries or so-called complaints from customers on high bills for electric lighting service rendered on a meter basis, only.

No.....

ADJUSTING BUREAU

District..... Date.....

Customer.....

Address..... Town.....

Refers to bill from.....to..... Amt.....

Complaint made by { servant / customer } by { Phone / Verbal / Letter }

Nature of inquiry.....

.....

.....

Signed.....
Employee

Referred to meter dept. for investigation.....

Returned by meter dept. on.....with Report No.....

Remarks.....

Answered on.....by letter as per copy

verbally by.....

FIG. 1.—COMPLAINT MEMORANDUM.

All employees who come in contact with the public should be thoroughly schooled in the art of courtesy. This is especially necessary to those answering telephone calls. The innocent telephone causes considerable trouble for the central station management, especially when it is the avenue for receiving inquiries or complaints. If the telephone could be eliminated, the treatment of inquiries and complaints would be comparatively easy.

Every telephone inquiry or complaint regarding a high bill, should be directed to the party who will make a final disposition of it. Many customers will use the telephone in giving a prolonged explanation regarding a high bill. After receiving this verbal explanation, it is well to request that a written explanation be sent in, together with the bill in question. In a large majority of cases, the complaint received later is not so formidable as the one received over the telephone. To some, it may seem cumbersome to have all complaints, other than those received in person, reduced to record. However, it works well in practice, as one becomes more conversant with his customer by this means. The next step necessary after receiving a complaint is to make an acknowledgment of it. The following is a sample form satisfactory for this purpose:

Replying to your inquiry of the 2d inst., relative to your lighting bill for the period from Nov. 1 to Nov. 30, amounting to $3.89, we desire to advise you that we have referred the matter to our meter department for investigation. We will advise you of the result of this investigation later.

A memorandum of the complaint is handed to the meter department with the request that the meter, wiring, lamps, etc., be inspected. Even though the company is small, the blank shown could be used so as to preserve a record of the work accomplished. (See Fig. 1.) The accompanying is a fair sample of the return report from the meter department. (See Fig. 2.) Having this information at hand, the customer is advised as follows:

Referring to your inquiry of the 2d inst. relative to your electric light bill for the month ending Nov. 30, amounting to $3.80, we beg to advise you that our inspector visited your premises Dec. 4, and made a very thorough inspection of your meter, wiring and lamps. He reports that the meter is in perfect condition and is registering accurately; also that the wiring is free from any defects whereby there could be a leakage of electricity. Our records show that your lamps have recently been renewed and are in good condition. We would suggest that the dust be removed from the latter periodically. By so doing, the efficiency of the lamp will be greatly increased. We have very carefully rechecked your meter cards and your bills, and beg to assure you that the bill as rendered is correct.

We respectfully desire to call your attention to the fact that the bill rendered covers a period in which the days are shorter than those of the previous month, and consequently more energy would be consumed.

Trusting this explanation is satisfactory to you, we beg to remain,

In correspondence of this nature the tendency is to be too abrupt, and it is surprising to note the results obtained by

DIST.....

METER TEST RECORD

No.....

NAME.....

ADDRESS.....

Type..... No..... Amp..... Volts'..... Constant.....

Old Meter Out.....190 Read.....

New Meter Set.....190 Read.....

Rev.	Sec.	Standard Watts	Meter Watts	Per Cent Fast	Per Cent Slow	Per Cent Load	Creeping
....	.....	.....	.....	.....	.....	.....	.....
....	.....	.....	.....	.....	.....	.....	.....
....	.....	.....	.....	.....	.....	.....	.....

REMARKS.....

.....

.....

.....

TESTED.....190 BY.....

FIG. 2.—RETURN REPORT FROM METER DEPARTMENT.

giving a customer a reasonable amount of time and attention. If a customer is questioning the accuracy of a meter after it has been thoroughly tested, it is well to extend to him the privilege of securing an expert at his expense and have the meter re-tested in his presence. Out of over one hundred such offers made by the writer, none were accepted.

Verbal complaints are the easiest to take care of and to settle satisfactorily. One of the most convincing arguments is to show a customer a meter in operation. It is well to install in the office a standard meter, connected to a bank of lamps of various candle-powers. The company should not take the arbitrary stand that it is always in the right. This should be proved by conclusive argument. Tact and diplomacy have saved many a customer, and have made satisfied customers out of those ready to send in a request to discontinue the service. The larger companies make a practice of testing and adjusting their meters periodically. Owing to the limited number of complaints which the average central station receives from customers having motors, these complaints will not be given consideration here. Complaints may be forestalled if the customer is taught to read his meter, so that he may be able to check up his bills. A number of companies send to the customer with his third or fourth bill, directions for reading meters, in the form of circulars, which serve a double purpose as they usually have an advertisement on the reverse side. "An ounce of prevention is worth a pound of cure" holds equally true in the electric lighting business as in other enterprises. It should be as much of the agent's or solicitor's duty to instruct the customer in the use of electric appliances as it is for him to secure his application; also to show him how to secure the best possible results for the least money. It devolves upon the solicitor to call upon the customer after he has been connected to the service to see if he is perfectly satisfied. This applies equally to the large and small customer. The time now seems ripe when the smaller companies are warranted in having a special agent to discover and fill the wants of the companies' present customers. The inauguration of a lamp renewal department often prevents a large number of complaints. Many companies now maintain such a department, the employees of which are constantly kept busy calling upon the companies' customers and renewing any burnt out or defective lamps. In conclusion, too much stress cannot be laid upon the importance of considering all complaints as inquiries.

Special Proposition for Residence Wiring at Wilmington, Ohio.

Mr. J. C. Martin, vice-president and manager of the Wilmington Water & Light Company, Wilmington, Ohio, has had in successful use for some time a plan to induce residence owners to wire their houses. Under this plan, the customer pays for the wiring in cash at the time the job is completed, but receives a rebate on his electric light bills until the bills aggregate an amount equal to a certain specified part of the cost of the wiring. In other words, the company gives him service for a certain length of time after his service is connected. The meter is read monthly, but no bill is presented until the customer has exhausted his credit. In the meantime, the family has contracted the habit of using electricity. They are always urged to take irons and as many devices as possible that consume energy. It would take two or three years to get them to use these under a different introduction plan. When his credit is used up, the customer may be surprised, but he has formed a habit that he will not care to change. The details of the method of determining how much of the cost of wiring shall be allowed on the customer's credit memorandum are interesting. The customer first fills out an application card on the accompanying form.

After this application is made and accepted by the company, an agreement is signed by the subscriber and by the company that the company will wire the premises complete at prices named in an itemized statement, which includes and specifies the items under Schedules A and B in the foregoing application. The company agrees that on the full payment of the total amount, the customer shall be entitled to a credit on his lighting bills for energy consumed to the amount of Schedule A. At the bottom of this agreement is a blank receipt which is signed by the collector when the job has been completed and

READ BEFORE SIGNING

Application to
WILMINGTON WATER & LIGHT COMPANY,
of Wilmington, Ohio.

The Subscriber _____ *wishes to have the following property wired for Electric Lighting, to-wit: No.* _____ _____ *Street, and hereby agrees to pay for same on the first of the month following the completion of the work.*

SCHEDULE A	SCHEDULE B
All wire used in work. All tubes, cleats and knobs. Fuse blocks, all solder and tape. All labor.	All rosettes, sockets, lamp cord, switches, lamps, shades and rings.

The total of all items listed under SCHEDULE "A" to be allowed as credit on future lighting bills.

This subscriber agrees to continue to use the current of this Company for lighting for one year after said credit is exhausted.

Signed _____ *Subscriber.*

Accepted _____

Date _____ *1907.*

This contract to be effective must be approved by the Manager of the Company.

Duplicate will be mailed subscriber.

APPLICATION CARD.

the customer pays for the wiring. This receipt certifies that the subscriber is entitled to credit on future lighting bills due the company to the amount of Schedule A, specifying the exact amount. Mr. Martin stated before the last convention of the Ohio Electric Light Association that he had increased the number of customers from 159 to 700 since 1903, this being one of the plans used to secure the increase.

Business-Getting Campaign at Dubuque, Ia.

The Union Electric Company, of Dubuque, Iowa, under the management of Mr. L. D. Mathes, has for several years been considered one of the most progressive of the Iowa electric lighting companies in seeking for new business. Although the returns in Dubuque have not been as great in proportion to the labor expended in solicitation as in some other towns, the management is by no means inclined to relax its efforts to get new and more profitable business. In fact, Mr. Mathes considers that in view of the recent financial panic there is likely to be more of a falling off in central-station business during the early part of 1908 than is customary after the holidays. For this reason he has arranged to spend considerably more money than ever before in retaining old business and in seeking new business to counteract the general tendency of customers to retrench.

Dubuque is a prosperous, but very conservative trading and manufacturing city of about 40,000 inhabitants, in which many of the people are of thrifty German descent. This class usually does not spend money freely or take to innovations rapidly. This being the case, an electric lighting company coming into a city where gas has been strongly intrenched for many years, has much hard work ahead of it to get electricity as extensively used as in some newer cities, and must spend more to get a given amount of new business. The gross earnings of the company for 1907 are about $3 per capita.

WINDOW LIGHTING AT FLAT RATES.

Last October a movement was begun to get merchants to make a flat-rate contract for window lighting, the company switching these lamps in and out of circuit at stated times. Formerly, each merchant had his window lamps connected to the same meter as the lamps in the rest of the store and had to look after the switching of window lamps on and off himself.

The result of this was, as is usual under such circumstances, that the windows would be dark many nights per week because the merchant would turn off the window lamps at the time of closing the store, as he would have no means of turning them off later in the evening without hiring some one to do it or to return himself for that purpose.

It was calculated that the average number of hours per day that a merchant's window lamps were burning under the meter system was about 1.5. The company went to the merchants with a proposition that the window lamps should be connected independently of the meter, and that the company should switch the window lamps into circuit each night at dusk and switch them out again at 10 p. m. every night except Saturday, when they are left in circuit until 11. They would thus average about four and one-half hours burning per night. For a merchant using electricity for lighting the interior of his store, the flat rate named in the contract was based on securing to the company a gross revenue of 6 cents per kw-hour. No rate, per kw-hour, however, is named in the contract. The contract simply mentions the amount to be paid per month, and the number and candle-power of the lamps. For customers who do not use electricity for the general lighting of the store, the contract for window lighting is figured at 8 cents per kw-hour. The company now has 31 flat-rate window and sign customers. Nearly

INEXPENSIVE STREET LAMP POSTS.

all of these were changed from a meter rate within about a month. Many of these customers added to their window lighting at the time the change was made.

The aggregate result of this change was beneficial both to the customer and to the company. The customers are getting the benefit of evening advertising, which they did not get under the old arrangement, and the company has changed the load which formerly averaged only 1.5 hours per night into one averaging 4.5 hours per night.

The rate secured for electrical energy for the flat-rate business is, to be sure, lower than the meter rate, or there would be no inducement for persons to change to the flat rate other than that of having the lamps turned on and off. On the other hand, the net revenue of the company for window lighting is, of course, considerably increased. By getting some of the more progressive customers on flat-rate window lighting contracts so that their windows were lighted every night, other customers were obliged to keep windows lighted every evening and to increase the amount of window lighting in order to make as good a showing. This they were able to do because of the lower rate. Thus the movement acted as a general stimulus to the window lighting business in Dubuque, and caused it to assume a much more important position than heretofore. It takes one man about two hours per day to switch the lamps in and out of circuit.

In order to understand the relation of the flat rate to the existing meter rates, it may be said that the rate for commercial store lighting is 14 cents for the first two kw-hours' use per month per 16-cp lamp connected and 6 cents for all over that. In other words, the customer gets the 6-cent rate as soon as he has used the equivalent of 40 hours' use per month of his connected load.

In the down-town district of the city the full number of rates are the same, except that only one-half of the connected load in lamps is counted, heating devices being omitted. In the down-town district there is also an optional rate of 14 cents for the first 50 kw-hours used and 8 cents for all above that.

FREE LAMP POLICY.

The company has taken up promptly with all the new high-efficiency lamps and furnishes free Gem lamps, together with reflectors whenever they are located in stores or placed where they yield a steady revenue. Such lamps would not be furnished free for out-of-the-way places where they would be used only occasionally.

As a result of this policy very extensive use is made of Gem lamps, as they are seen everywhere in the down-town district. Much of the window lighting is done with Gem lamps in concentrating reflectors. The lamps are suspended from the ceiling of the window and are usually visible from the street. While this arrangement does not give as much illumination on the goods as some concealed systems do, it answers very well for conditions in the small city where the attractive appearance of the lamp itself is considered desirable, as well as illumination on the goods. Considerable light is thrown out on the sidewalk with this plan.

SOLICITATION AND ADVERTISING.

The company employed two solicitors up to Oct. 1, 1907, since which time three solicitors have been employed. The superintendent of the lighting department, Mr. H. G. Gorr, also makes estimates on large motor installations. The company has a very economical steam turbine-driven generating plant, and is gradually acquiring a load from some of the large factories in Dubuque.

From $75 to $80 per month is being spent in advertising in the two daily newspapers. Some is also spent for advertising in entertainment programmes and other places where the advertising value is doubtful, but where the company wishes to offer its support and good-will to the organization having the matter in charge. The regular space in the daily newspapers is 5 ins. double column. The same advertisement is inserted in both papers for a week and then changed. The company subscribes to the Curtis Advertising Company's monthly bulletin for distribution among present and prospective customers.

ELECTRIC TOASTERS.

Recently a special effort has been made to introduce the new electric toaster made by the Pacific Electric Company. This is believed by Mr. Mathes to be one of the best devices to push, next to the electric iron, because it is likely to yield a fairly steady revenue after once introduced, and it gives such excellent results. A circular letter was written offering to loan these toasters free to customers on thirty days' trial. They are sold at $4.90 each, and the company guarantees to maintain them, except for damages caused by misuse. About 40 toasters have been put out in this way.

LIGHTING OF OFFICES.

The company has offices on the main street which are fitted up in good taste, but without elaborate display. A few of the principal heating devices, and several sizes of motors, are kept on exhibition. Probably the most striking thing about the offices is the way in which they are lighted. The lighting is done by means of Gem lamps in type B bowl-shaped reflectors placed near the ceiling. They are suspended from the ceiling

in a symmetrical design. The lamps have frostel tips and the bowl reflectors cover the lamp sufficiently so that no direct, undiffused glare from the lamp filaments can be seen. The result is a very pleasant and comfortable illumination, even though the lamps are large, being of the 187-watt and 250-watt size. The watts per square foot are 2.15, and the illumination on the

Electricity in Modern Advertising.

One of the fundamental rules for successful advertising is that the advertisement shall appeal to the eye. It is universally recognized by advertisement writers that much depends on the display, so that consciously or unconsciously the appeal of the

FIG. 1.—VIEW OF BROADWAY, NEW YORK, LOOKING NORTH FROM TIMES SQUARE.

desks is probably not less than 4 foot-candles, this illumination being very uniform over the entire room.

ORNAMENTAL, INEXPENSIVE STREET LAMP POSTS.

In front of the offices and of the Julien Hotel, next door, a row of ornamental lamp posts has been installed, which is shown herewith. These posts are inexpensive, yet neat in appearance, and may give some good ideas in this line to others planning lighting of this kind. The lower parts of the post consists of lengths of different sizes of steam pipe fastened together with reducing nipples. The ornamental goose-neck was purchased from an electrical supply company.

writer of advertising is not primarily to the reason, but to the sight.

The ultimate aim of any advertiser is to make the name of his product so well known that when one thinks of a particular article, or has a desire for it, he will recollect the advertiser's brand, and to this end the advertisement is so devised that a retinal image of the particular product, or of its name or trade mark, is readily transferred to the brain of the public. As one writer on publicity has said: "What devotee can readily forego the spell cast by the electric time recording sign with its direct command: 'Time to Take a Wilson Highball,' when seated in a club or cafe, after watching the marvelous working of its electric mechanism and play of light."

FIG. 2.—VIEW OF FORTY-SECOND STREET, WEST OF SEVENTH AVENUE.

This leads up to the illuminated advertisement or the electric sign. The enormous increase in the use of electric signs throughout the United States simply means that its possibilities as a trade bringer are becoming recognized. When the electric sign was first introduced it consisted of a painted surface illuminated by electric lamps. Gradually individual letters studded with incandescent lamps came into use, then the talking sign, followed by the animated electric sign. No single feature has contributed so largely to the growing popularity of this means of advertising than the easy adaptability and flexibility of the electric sign in fulfilling the requirements of advertisers; while the low cost that attends even a lavish use of electricity for purposes of advertising is an additional incentive to use this form of publicity.

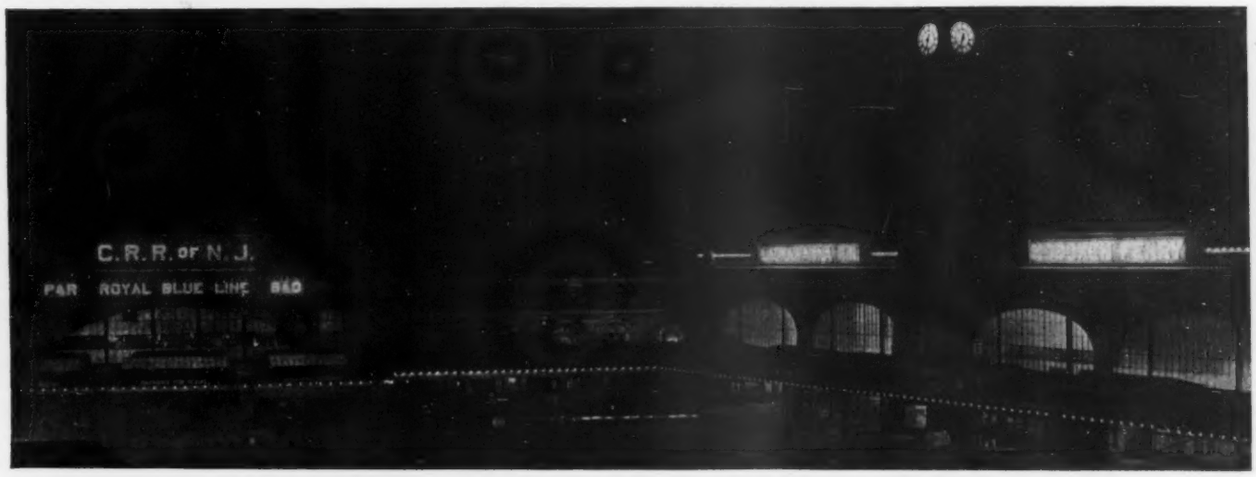


FIG. 3.—SIGNS ON FERRY HOUSE AT TWENTY-THIRD STREET AND HUDSON RIVER.

The sign of the time is unquestionably the electric sign. Probably nowhere is this more noticeable than in and around New York City, where it would seem every available roof, wall and vacant lot space is utilized to exploit the merits of some modern commodity. Visitors to the metropolis cannot be but strangely impressed with the wonderful showing. Some idea of the efficiency and popularity of advertising in New York City may be gained from the rental paid by one of the outdoor advertising companies for the roof privileges at Broadway and Thirty-fourth Street facing Herald Square. The yearly rental of this desirable location on a three-year contract is reputed to be $50,000.

FIG. 4.—RAILROAD FERRY SIGN ON TWENTY-THIRD STREET.

The commodities advertised by means of the electric sign include everything salable. No matter if it be a name, a brand of goods, or a place that the advertiser desires to impress on the mind of the public, he finds that the electric sign answers the purpose best. The demand for more light is becoming greater and greater, and with the increase of light comes the safety of travel at night. Advertisers appreciate the fact that the greater the amount and the longer the hours of illumination the later does the hour for retiring become.

The advertiser who obtains the greatest benefit from an electric feature is the one whose ideas and sign are large enough to startle the public. There are approximately 2000 hours of darkness in a year between the hours of dusk and midnight. If the class of goods advertised is such that it might attract the attention of the general public, these hours are good for advertising in, since those who patronize the theaters, social affairs, and the functions which cause them to be around late at night, have great purchasing ability. Every theater of any consequence is equipped with an electric sign and on the principal streets of almost every live town are to be found illuminated signs, windows, etc., to attract the attention of people at night when the cares of business life are set aside.

The merits of electrical advertising are independent and self-sustaining if the business or commodities advertised are worth advertising. All of the large outdoor advertising companies use it in large cities both here and abroad. In Paris, for instance, there are over 3000 electric signs in use and one company pays over $40,000 per annum for electricity used for this purpose.

FIG. 5.—ARTISTIC SIGN ON BROADWAY.

It is significant that the national advertisers are great users of electric signs. In all of the large cities of the country and on their factories and salesrooms, these national advertisers have erected magnificent signs of huge proportions. Along the railroad tracks may be seen factories with large electric signs on their roofs. Boards of Trade in numerous cities have erected signs for the purpose of advertising their cities. In fact there is no business or attraction which appeals to the public that cannot be advanced by the use of electric signs

Before the era of electric illumination of show windows and signs, the merchant pulled down his shades when the store was locked for the night. His business stopped, although his expense went on. Now the multitude at night is attracted to the windows by tempting displays well lighted until midnight and the desire to purchase is aroused. To electric signs and electrically lighted windows many cities owe their brilliantly lighted thoroughfares.

Electric light companies oftentimes supply the electric energy for the lamps at a flat rate, the company controlling the circuit. The service extends to midnight and the lamps are switched into and out of circuit by a time clock or by a man employed for that purpose. The majority of the lamps used in signs are of four candle-power, although 2-cp, 8-cp and 16-cp lamps are often used. Where bill boards are illuminated, arc lamps, flaming arc lamps and 16-cp incandescent lamps are used, the arc lamps being provided with shades and reflectors and hung some distance from the sign and about abreast the center. Incandescent lamps are placed in troughs suspended about 6 ft. from the sign and even with the top of it.

It is not the purpose to touch on spectacular advertising in this article, and by that is meant signs operated by flashers or other motor-driven devices, since these will be covered in a subsequent article. The accompanying illustrations show portions of "The White Way" of New York City. Fig. 1 showing the view looking up Broadway from Times Square, although scarcely doing the thoroughfare justice owing to the shortcomings of the photographic art, gives an idea of the extent to which electricity is employed for sign lighting in New York. Fig. 2 shows a view looking west on Forty-second Street from Seventh Avenue. This shows the heart of the theater district. Broadway at this point is a bewildering confusion of electric and painted signs that in itself is sufficient to interest and amuse the visitor to the city. Much has been written on the sign display along Broadway; but so many new and novel signs constantly appear that the subject never really grows stale.

Broadway, however, does not monopolize all of the electric signs in New York City, nor is New York the only city in which electric signs exist. It is surprising to note how the railroad companies have taken to the electric sign and also to what an extent electric signs are used along New York's river front. In the latter case the use of immense signs is in a measure restricted owing to their effect upon navigation. Figs. 3 and 4 show signs at the railroad ferries at Twenty-third Street and the Hudson River. Those shown in Fig. 3 are lighted with incandescent lamps, while the word "Erie," in Fig. 4, is lighted by mercury vapor lamps.

Many of the large signs in New York and other cities used by national advertisers are very artistic by day and by night. These are usually erected on steel frame-work with individual letters and borders, the trade-mark oftentimes being painted on glass behind which incandescent lamps are placed. The lamps used are either colored glass or are fitted with color caps, and at night, the steel frame-work being invisible, the color effect is beautiful. Fig. 5 shows one of these signs.

Electric signs are used by the leading theaters of the country and within the past few years the number of such signs has increased enormously. The greater part of the theater signs are made of angle iron with individual letters, the feed wires for which are carried in conduit back of the supporting rails. "T" outlets are provided every 12 ins., through which a spur of wire projects and on each spur is fastened a copper connector bushed with rubber tubing and compound.

The Electric Flat Iron.

By W. J. Barr.

One of the most difficult problems in the manufacture of electric heating appliances is the construction of the heating elements so that these will stand the occasional neglect of remaining in circuit when not in use; give even distribution of the heat generated, be quick acting and yet not overheat. The electric flat iron, now turned out by many manufacturers, no longer gives any serious trouble, and conservative central station men, who have heretofore regarded the sale of these devices as imprudent, may now introduce them with confidence of permanent results. More attention has been given to the manufacture of the flat iron lately because it has a great commercial value, and because it of all heating devices is best appreciated in the home supplied by electricity.

While the electric iron is gradually becoming a salable article in department and other stores, it is not yet so well known or understood as to make it much of a factor in the sale of electrical energy. For several years to come, it may be necessary and advisable for electric light companies to make vigorous "introducing campaigns." The 30-day trial proposition, so much in vogue at present with central station men already engaged in this work, has been a pronounced success. The reported "returns" have not averaged more than 5 per cent and with the improvements this should be very much lessened.

It has been intimated from many sources that a reduction in price of all heating appliances would be beneficial. To the purchaser not conversant with the convenience of the electric flat iron, the present price doubtless injures quick sales. It is questionable, however, whether price reductions will obtain. There was a period when incandescent lamps cost 30 cents; later they could be purchased for as low as 10 cents, and now many are willing to pay 60 cents each for lamps of recent invention; and engineers firmly believe that these high-priced lamps are the lamps of the future. It is not likely that heating appliances will increase in price in this ratio, but necessary improvements will add to the cost of construction and, as with the high-efficiency lamps, people will be willing to pay the added cost. The improvements referred to are such as will assure long life to the heating units, together with the introduction of devices to render the flat iron impossible of overheating.

The present price, however, should in no way limit the sale of the electric flat iron. In order to substantiate the claim of convenience, the central station management must permit free use of these appliances for a period. If after investigation it should be considered impossible to effect sales because of the poor clientage, it should be borne in mind that electric flat irons can be given away with profitable results.

Much of the general advancement in the manufacture of electric flat irons and cooking utensils has been due to the counsel given by central station men to the manufacturers of such apparatus at several conventions; and the manufacturers have not been lax in following advice that will result in enhancing the security, comfort and enjoyment of heating devices.

Letter to the Editors.

Capitalizing New Business Investments.

To the Editors of Electrical World:

Sirs:—An interesting and important question relating to American central station finances is whether money spent in building up central station earnings in a commercial way be charged as investment, just as is money spent in building up the tangible, physical property. This question has not come up in this exact form to any extent as yet because of the small amount of commercial cultivation done by most central station companies prior to three years ago, and because of the general custom of charging money spent in getting new business to operating expenses. The practice of charging all expenses of the commercial de-

partment to operation is safe and conservative, but it would seem illogical to deny to a corporation the privilege of charging to capital account investment which is essential to the earning power of the business. If a central station company can by organized solicitation secure profitable business and thereby can put itself on a dividend-paying basis where otherwise it would pay nothing, there has certainly been something put into the business in the nature of an investment. This question is of immediate practical importance in two connections. One of these is where a company has just spent considerable money enlarging its plant and will have an idle investment upon which to pay interest if money is not spent in getting enough business to put this investment to work.

Another practical bearing of the question relates to appraisals and reports to state public service commissions which control the issuance of securities and other financial operations of electric lighting companies. The commissions have been generally inclined to the idea that only physical property should be included in capital or investment charges. This has been on the theory that whatever is earned over and above fair interest on physical value of the property represents value of the franchise, and that the franchise belongs to the people, who should receive whatever benefits are derived therefrom, either in the shape of taxation or increased rates. This theory is coming to be rather generally accepted as regards public utilities in which there is little risk. As regards central station enterprises, however, there is enough risk to call for some compensating advantages in the way of possible greater returns than common rates of interest, in order to induce capital to invest in such enterprises.

But, even taking all these things into consideration, thus far there has been no recognition of the principle that allowance should be made for money spent in purely commercial development and which in the general business world is capitalized under the head of "good name." It is undoubtedly true that the gates should not be opened to loose practices in charging money spent in commercial development to capital account. An immense amount of money can be wasted in misdirected commercial attempts at promotion. On the other hand, much money is frequently wasted on the physical property of a company through bad engineering judgment and the purchase of apparatus unsuited to the company's needs.

NEW YORK, N. Y. CHARLES L. FORD.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Covering Open Slots.—R. GOLDSCHMIDT.—The author has made experiments to improve the quality of direct-current machines with open slots by covering the slots with pieces of iron. Methods of doing this are described and the results of experiments show that the heating, the iron losses, and the exciting current are diminished.—*Elek. Zeit.*, Dec. 5.

Induction Motors.—R. GOLDSCHMIDT.—The first part of a theoretical paper in which the author develops methods for the calculation of the no-load current and the leakage reactance of three-phase, two-phase and single-phase induction motors, taking account of all influences as far as possible.—Lond. *Electrician*, Nov. 29.

Lamps and Lighting.

Carbon-Filament Lamps.—With reference to the article of Teichmueller, recently abstracted in the Digest, on standard carbon-filament lamp specifications in Great Britain and Continental Europe, the great difference between the official definition of a good carbon lamp in the United Kingdom and in Austria, Germany and Switzerland is pointed out. This is chiefly due to the fact that the German hefner candle is only 0.88 British candle. The following comparisons between a British standard 220-volt, 800-hour 16-cp lamp and a Continental 16-hefner-cp lamp rated at the same life and voltage, are instructive:

	British Standard Lamps.	Continental Standard Lamps.
Candle-power (British)	16.	14.
Total watts	65.6	63.
Watts per candle-power	4.1	4.5

A comparison of the British 8-cp with the foreign 10-hefner-cp of the same voltage and rated life is still more useful:

	British Standard Lamps.	Continental Standard Lamps.
Candle-power (British)	8.	8.77
Total watts	36.	45.
Watts per candle-power	4.5	5.13

The difference in specific consumption, it will be seen, is actually 24 per cent in favor of the British lamp. A further examination of the foreign official standards shows that an 800-hour 8-cp British lamp has a lower initial specific consumption than a 600-hour standard Continental lamp.—Lond. *Elec. Eng'ing*, Dec. 5.

Metallic Filament Lamps and the Central Station.—An anonymous article "by a lamp maker," who says that the low-efficiency carbon-filament lamp is doomed and that the metallic-filament lamp will surely take its place. He says that the 8-cp, 8-watt lamp of high voltage is surely coming. It has been argued that as a result a loss of revenue might be expected in central stations, but that the decreased revenue would be balanced by an increased use of electric light. The author thinks this argument is all wrong. He says the householder is not going to use any more light than he really needs. The commercial lamp unit is now quite as high as the present standard of domestic comfort desires, and although in time it may increase somewhat, it will not do so to any appreciable extent. If under the present method of distribution of electric light and rates of charging new outlying districts should be attracted, the author thinks that this will not provide sufficient revenue to balance the reduction in the income from present customers. On the contrary, under existing methods of charging it will be financially disastrous to couple up the additional customers. The author gives various figures and estimates to prove this, and his conclusion is that the metallic-filament lamp has come to stay and that radical alterations in systems of connections and charging will be necessary unless disastrous results are invited. What radical alterations he advocates, he does not say in detail. Lond. *Electrical Engineer*, Dec. 6.

Street Lighting.—H. HARRISON.—A note on the lighting of three London streets with similar types of lamps. The tests were made with a universal flicker photometer measuring direct illumination. The results showed that illumination obtained depends not only on the lamps used, but also on the method of their installation. The low minimum illumination in one of the three streets is to a large extent due to the low candle-power of the two lamps at rays approaching a horizontal, which is accentuated by the lamps not being erected as high as they should be. The good results obtained in the best lighted of the three streets are due simply to the correct arrangement of the lamps in proper distances and at proper heights, and have not involved any appreciable increase of cost.—Lond. *Electrical Review*, Dec. 6.

Plain and Frosted Lamps.—E. P. HYDE AND F. E. CADY.—A long illustrated paper giving a comparative study of plain and frosted lamps. This paper is an enlargement of the National Electric Light Association paper of the same authors.—*Bull. Bureau of Standards*, Vol. 4, No. 1, December.

Power.

Cost of Steam Power Plants.—F. KOESTER.—An article giving figures on the cost of constructing steam-driven electric power plants. The figures represent average recent practice and are quoted per kilowatt of rating. The superstructure for plants up to 5000 kilowatts costs from $15 to $25 per kilowatt, for

larger size plants from $10 to $20. A radial brick chimney for large-sized power plants costs from $1.75 to $2.25 per kilowatt; reinforced concrete chimneys and plate-steel chimneys may cost from $1.50 to $2. The figures for equipment for handling coal and ashes range from $1.50 to $3; those for cost of water-tube boilers from $8 to $10, with from $2 to $3 extra for mechanical stokers. Steam-driven blowers for induced draft cost $1 per kilowatt. Where economizers are installed of sufficient rating to heat water from 200 to 220 deg. F., they cost about $2 per kilowatt. The cost of boiler-feed pumps alone is some 50 cents per kilowatt; when storage tanks are necessary, the combined outfit costs from 75 cents to $1. Piping may cost from $2 to $6. For plants varying from 10,000 to 20,000 kilowatts in rating, the piping system not being elaborate, but sufficient for continuous operation, from $2.50 to $2.75 has covered the cost, including a high grade of covering for steam piping. A 5000-kw turbo-generator should cost from $20 to $22 per kilowatt. Reciprocating engines of this rating are sold at roughly the same price, and about $10 per kilowatt is to be added for the generator. The total cost for smaller units, of from 600 to 3000 kilowatts, is from $20 to $25 per kilowatt, whether they consist of turbine or reciprocating-engine apparatus. The cost of jet-condenser equipment runs from $3 to $5 per kilowatt; that of surface-condenser apparatus from $5 to $8, though it may be less in special cases. A steam-driven exciter unit costs from 35 to 40 cents per kilowatt. If a condenser should be installed in connection with it, the cost may run as high as 70 cents per kilowatt, assuming that the exciter rating is equal to approximately 1 per cent of the total rating of the plant. For high-tension equipments, the cost of the switchboard runs from $2 to $3.50, while for low-tension (2300 volts or less) the switchboard costs from $1 to $2 per kilowatt. There are many other items, such as traveling cranes, which will amount to 25 to 50 cents per kilowatt. Smaller items, like house pumps, water meters, etc., may total from $1 to $2 per kilowatt. In tabulating the total costs of a power plant, separate figures are given by the author for steam-turbine plants and reciprocating-engine plants. The cost of a steam-turbine plant per kilowatt, when exceptionally low, is $65, and a fair average is $103. The corresponding figures for reciprocating-engine plants are $70.25 and $104.50. But plants have been installed which cost as much as $125 and $150 per kilowatt. All these figures refer to plants of large rating. Small plants of about 3000 kilowatt rating have been erected in the West at from $120 to $130 per kilowatt, which cost may be reduced if a simple combination of machines is provided.—*Eng'ing News,* Dec. 19.

Superheat.—Ulrich.—A review of the use of superheated steam in electricity plants. The limit to which it is economical to superheat the steam is determined by the saving of steam and fuel on one hand, and the extra expense of first cost and maintenance of the superheaters on the other hand. Only a few of the older reciprocating steam engines are suitable for effective superheating, although with old boilers with very wet steam and badly utilized heating gases even the drying of the steam may have economical advantages. Even with the more modern reciprocating engines it is economical only in exceptional cases to superheat to more than 250 deg. steam temperature. It is different with steam turbines, which are suitable for superheating to 500 deg. almost without exception.—*Elek. Zeit.,* Dec. 5.

Power from Peat.—T. Tomlinson.—The author discusses the possibilities of utilization of peat for energy production in Ireland, and seems to favor the use of peat in gas producers for the production of power in gas engines with simultaneous recovery of the ammonia.—Lond. *Electrical Review,* Dec. 6.

Electric Power in Iron and Steel Mills.—W. E. Reed.—In iron and steel mills special arrangements must be made to overcome the disadvantages of the large fluctuating loads. In a continuous mill this is simply accomplished by increasing the flywheel effect. On the other hand, in reversing mills when the rolls are to be reversed, the kinetic energy, or flywheel effect, of the reversing parts should be reduced to a minimum. One form of equalizer that is suitable for these requirements consists of a motor-generator flywheel set connected between the roll-driving motor and the source of energy. A recent continuous mill installation is that of the Edgar Thomson Steel Works, which is equipped with two 1500-hp, compound-wound, 220-volt, 100 to 125 r. p. m. direct-current motors, which are direct connected to the rolls. A 125,000-lb. cast-steel segmental flywheel, 18 ft in diameter, is mounted on the motor shaft to assist in equalizing the load on the motor and power house The speed of the motor drops from approximately 125 to 90 r. p. m. in actual operation, which allows the flywheel to take care of the peak loads. A reversing mill installation is at the Hildegrade Works, in Australia, which has already been noticed in the Digest. Another is at the Illinois Steel Works.—*Elec. Journal,* January.

Electric Motors in Textile Factories.—W. B. Woodhouse.—A paper read before the Bradford Engineering Society on the use of electric motors in textile factories. Since a very large proportion of textile machines are required to be run at a constant speed, the most suitable type of motor is the alternating-current induction motor. The individual drive has important advantages, due to the elimination of belts, gearing, shafting and resulting in the reduction of power, and the advantage of freedom from limitations as to the position of machines. In the matter of capital cost, the electric drive effects considerable saving in a new mill. The building may be much lighter in construction. Moreover, there is an important increase of output due to the steadiness of speed.—Lond. *Electrician,* Nov. 22.

Electric Motors in Cement Works.—A fully illustrated description of the electric motor equipment of a British cement works. Direct-current motors are employed on a three-wire system, so as to get a fairly wide range of speed.—Lond. *Electrical Eng'ing,* Nov. 28.

Electric Cranes.—H. H. Broughton.—A continuation of his illustrated serial. In the present instalment the author discusses the brakes necessary in connection with crane motors. These may be either electrical or mechanical, although the latter are not now much in use. Brake-releasing electromagnets are then dealt with, and a description is given of one made by the Helios Company. The author concludes with a description of the solenoid brake made by Siemens Brothers.—Lond. *Electrician,* Nov. 22.

Cranes.—A brief description, with illustrations, of the electric crane equipment of the new steamers *Lusitania* and *Mauretania.* The equipment consists of four deck cranes and four baggage and mail hoists.—Lond. *Elec. Engineering,* Dec. 5.

Energy Transmission by Alternating Currents.—C. Breitfeld.—An article in which the author shows how to determine a certain important constant in Roessler's theory of energy transmission by alternating current.—*Elek. und Masch.,* Nov. 24.

Traction.

Brake.—An illustrated description of a new electromagnetic brake devised by A. W. Maley. No braking effect whatever is exerted on the wheels, and reliance is placed entirely on the braking effect upon the track. The brake is a combination of slipper blocks in front of and behind a powerful electromagnetic brake, the whole acting on the track. A side elevation of the device is depicted in Fig. 1, which shows how the magnetic brake is linked up mechanically to the leading and trailing shoes. The descent of the magnet also causes the shoes linked up to it to make contact with the rail, and the three blocks exercise a powerful retarding effect on the car. The magnets are excited either by the current taken from the motors acting as

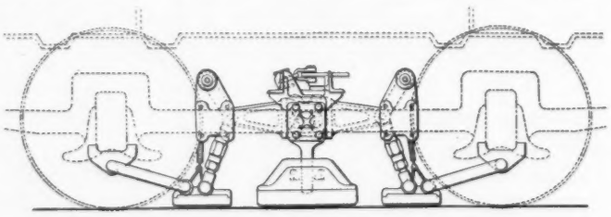


FIG. 1.—DIAGRAM OF BRAKE.

generators or by the operation of a special canopy switch; they may be energized directly from the trolley wire. It is claimed for the equipment that it affords three distinct brakes, two of which may be applied instantaneously, and no one of which reduces the braking effect if simultaneously applied with any of the others. The first brake is the electromagnetic track brake operated in conjunction with the motors, being suitable for all purposes, service, emergency and coasting. Second, there is the electromagnetic brake operated from the trolley line, which represents a powerful emergency brake. Thirdly, there is a manually-applied track brake suitable for service and coasting, and, in the event of failure of both the first and second brake, it represents a better reserve brake in case of runaway than existing wheel brake. Tests recently made at Leeds appear to have given very satisfactory results.—Lond. *Electrician*, Nov. 29.

Installations, Systems and Appliances.

Knife Switches.—W. O. MILTON.—A second article in his illustrated serial on circuit-interrupting devices. The author discusses various points of the design of knife switches with reference to the rules of fire underwriters. Switches are generally made of the best hard-drawn copper with a current density of from 800 to 1000 amperes per sq. in. of cross-section area and from 50 to 75 amperes per sq. in. of contact surface. In the construction of the base, slate or marble is efficient in radiating heat. The radiation increases somewhat more rapidly than the rise in temperature, and since the heat generated varies as the square of the current, the temperature rise will be somewhat less than proportional to the square of the current. Thus a switch which will carry 1000 amperes with 20 deg. rise will carry 2000 amperes with about 60 deg. rise. The underwriters require that knife switches must operate successfully at 50 per cent overload in amperes and 25 per cent excess in voltage, under the most severe conditions with which they are liable to meet in practice. To make sure this is the case, the following minimum breaking distances and spacings between poles of knife switches for 250-volt service should be carefully maintained.

Amperes.	Minimum separation of metal parts of opposite polarity	Minimum break distance.
10 or less	1½ in.	1¼ in.
11 to 30	1¾ "	1½ "
31 to 100	2¼ "	2 "
101 to 300	2½ "	2¼ "
301 to 600	2¾ "	2½ "
601 to 1000	3 "	2¾ "

Generally the following two tests are made: A drop test and an insulation test. The drop test consists in taking the drop across the switch at full load. This should not exceed about 12 millivolts from jaw block to jaw block. The principal object of this test is to insure good contact between the jaws and blade. Moreover, a reasonably small temperature rise is assured if the drop is low. The insulation test consists in testing between break and hinge jaws with switch open, between opposite poles, and from jaws to ground. In the test an e. m. f. of from 3000 to 5000 volts is used, the principal object being to test the base. In order to prevent surface leakage the distance from nearest live metal part to ground should never be less than ½ in. For cross-bars, wood is most suitable; it should be thoroughly dried and treated so that it will not absorb moisture. In the design of lugs, all sections should be large enough to afford about 1 sq. in. for each 800 amperes where copper is used, and for brass lugs the sections should be larger in proportion to the reduction in conductivity.—*Electric Journal*, December.

Starting and Protecting Alternating-Current Motors.—A description of a device for starting and protecting alternating-current motors. The arrangement suitable for a three-phase induction motor is shown in Fig. 2; it is fitted with an overload coil, which is in series with a secondary, and the no-voltage release coil which is connected across one of the primary or stator phases. *R* is the rotor, *S* is the stator, *L* the line, *A* the overload coil, and *B* the no-voltage coil already referred to. The overload coil *A* is disposed in such a manner as to open the circuit of the no-voltage release coil *B* in case it should operate; that is, if an overload should occur. Fig. 2 shows the connections when the motor is running. In starting up the motor the brush-carrying lever *C* closes first the primary or stator circuit of the motor, and is then successively moved over the various contacts C^1, C^2, C^3, C^4, C^5, finally reaching the last contact C^6, or the running position, where all the resistance is cut out, and where it is held closed against the tension of a spring *D* by a suitably arranged hook *H*. The spring *D*, for commercial purposes, is really situated in the center of the brush-carrying lever *C*, but for the sake of clear illustration, it is here arranged as shown in the illustration. To make clear the working of the device, we will suppose that through some cause the supply is cut off from the motor. In such a case the no-voltage release coil *B* receives no current, and will consequently release its core, which is arranged so as to fall down on the hook *H*, and the brush-carrying lever *C* at that moment, through the influence of the spring *D*, flies back to the "off" position and thus disconnects the motor from the line. If the motor is overloaded, it is obvious that the current in the rotor circuit will increase in practically the same proportion as the stator or line current, and the overload coil, therefore, will operate. In doing so the coil opens the circuit of the no-voltage release coil *B*, and the brush-carrying lever *C* again flies back to its "off" position as before, thus disconnecting the motor from the line. If the supply should be cut off on one of the phases only, as sometimes happens when one of the main fuses blows or through the breakage of a wire, the machine will continue to run as a single-phase motor, but the rotor current will increase

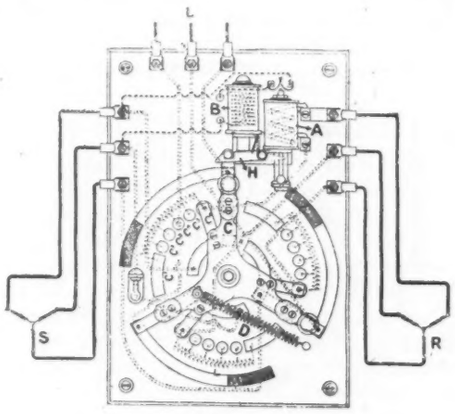


FIG. 2.—DIAGRAM OF CONNECTIONS.

in a most dangerous manner even if the motor carries only a comparatively small load. The overload coil *A* in such a case will immediately operate and this causes the motor to be cut off from the line as before.—Lond. *Electrical Review*, Dec. 6.

Special Applications of Standard Transformers.—H. W. YOUNG.—In a case in practice it was important to install without delay transformers for raising the e. m. f. from 360 volts primary to 2400 volts secondary. This became possible by means of ordinary standard transformers as follows: Both a standard transformer for 120-volt primary, with a 20 to 1 ratio, and a standard transformer for 240 volts primary, with a 10 to 1 ratio, give 2400 volts secondary. Since 120 + 240 equals 360, it will be seen that if two transformers were used with their high-tension windings in parallel at 2400 volts and their low-tension windings in series, one connected for 240 and the other for 120 volts, the group would operate at a ratio of 360 to 2400 as desired. This was successfully done in the case in practice, where 15 kilowatts were to be dealt with. It may be noted that full-load current for the 10-kw transformer at 240 volts corresponds to the current of the 5-kw transformer at 120 volts, thus permitting the operation of the transformers in series on the low-tension sides, as indicated. The author shows some other special applications of the regular types of transformers and deals with the following two problems in detail: The first is to get 7.5 kilowatts at 500 volts from a 60-cycle, 1000-volt circuit with the standard transformers avail-

able. The second problem is to get 250 volts for starting and 400 volts for running a three-phase, 20-hp, 60-cycle motor from a 1150-volt line.—*Electric Journal,* December.

Wires, Wiring and Conduits.

High-Tension Cables.—C. Feldmann and J. Herzog.—An article on the construction and testing of high-tension cables with special reference to grading the insulation. Commercial cables for e. m. f.'s of from 25,000 to 30,000 volts are now available, and are quite satisfactory. Long tests with the use of double or three times the normal voltage may weaken the interior layers of the insulation without the cable breaking down during the test. It is, therefore, preferable to make short tests with a moderately increased voltage. Such tests are fully sufficient to find any weak points of manufacture.—*Elek. Zeit.,* Dec. 5.

Cable Drum.—H. Schultz.—An illustrated description of a transportable cable drum used by the German telegraph department and operated by electricity, the generator being driven by a gasoline engine. These machines and the cable drum are placed on two trucks.—*Elek. Zeit.,* Nov. 28.

Fuses.—An account of the discussion which followed the recent Berlin Electrical Society paper of Meyer on theory and practice of fuses. Emde gave some notes on the operation of fuses on the basis of Fourier's theory of conduction of heat.—*Elek. Zeit.,* Nov. 28.

Wooden Poles.—R. Nowotny.—An article on the life of wooden poles in Austrian transmission lines. In view of the increasing cost of wood, it is important to counteract the gradual destruction of the wood, and for this purpose the Austrian Telegraph Department is making experiments with new methods of impregnating poles for their protection.—*Elek. und Masch.,* Dec. 1.

Electrophysics and Magnetism.

Weighing a Magnet in Varying Magnetic Fields.—L. A. Bauer.—An abstract of an American Physical Society paper on results of careful weighings of a magnet in various magnetic fields. The magnet was weighed in two horizontal positions, and also in two vertical positions at various places in Canada and the United States. One of the conclusions of his measurements is that the mean result of weighings of a magnet in two positions 180 deg. apart will not necessarily give the true weight or, say, the weight which the same substance would have if demagnetized. This was proved also by repeated magnetizations and demagnetizations of two different magnets. To get the true weight of a magnet within the accuracy attainable with the balance used, the weighings of the substance when magnetized would have to be made for at least eight equidistant positions.—*Physical Review,* December.

Radium Emanation.—A. S. Eve.—A paper on the amount of radium emanation in the atmosphere near the earth's surface. The emanation in the atmosphere is absorbed by cocoanut charcoal; its presence can be proved and its magnitude determined. The author has made four measurements at Montreal, and the results are given in terms of the amounts of radium required to maintain the supply per cubic meter constant. The amount of emanation is of the correct order to account for the active deposits of radium-C which may be collected on negatively charged wires from the atmosphere.—*Phil. Mag.,* December.

Magnetic Testing of Iron.—W. H. F. Murdoch.—A paper describing a simple permeameter for workshop testing of iron

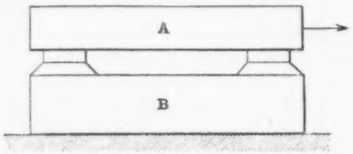


Fig. 3.—Magnetic testing of iron.

which has the advantage that the material tested may be in very large pieces. The accuracy aimed at is about 5 per cent. The arrangement is indicated in Fig. 3, where *A* is the bar to be tested and *B* the yoke. A tractive effort is exerted on *A* in the direction of the arrow by means of a weight suspended over a roller. The friction pull is determined both with magnetized and unmagnetized magnetic circuit.—Lond. *Electrician,* Nov. 29.

Miscellaneous.

Wireless Telegraphy.—F. A. Fleming.—His full (British) Physical Society paper on the theory of magnetic oscillators as radiators in wireless telegraphy.—*Phil. Mag.,* December.

BOOK REVIEWS.

Society for the Promotion of Engineering Education. Vol. 14. Edited by D. C. Jackson, C. L. Crandall and W. T. Magruder. New York: Engineering News Publishing Company. 300 pages. Price, $2.50.

This volume contains the proceedings of the fourteenth annual meeting of the Society for the Promotion of Engineering Education, held in Ithaca, N. Y., last year. Several of the papers treat subjects of specific interest to the electrical engineer, and almost all the remainder have a general interest for him, as they treat of various phases of engineering education in general. Among the former class of papers are one by Prof. Henry H. Norris, of Cornell University, on "Blank Forms for Use in Electrical Engineering Instruction," a topical discussion as to the profitability of undergraduate instruction in the design of electrical machinery; "Work in the Mechanical and Electrical Engineering Laboratories of Sibley College," by Prof. R. C. Carpenter. Prof. Charles F. Burgess, as chairman, submitted the report of the committee on technical books for libraries, which includes a list of periodicals and books on science and technology for the reference library, and lists corresponding to the various branches of engineering. Those for electrical engineering are grouped under the heads of electricity and electrical measurements; dynamo-electric machinery; electrical power transmission; telephone and telegraph; electrochemistry and batteries; miscellaneous applications of electricity. Related subjects covered by lists are inventions and patents, materials, drawing and designing. Biography is also represented by a list of books.

The Standard Handbook for Electrical Engineers. New York: McGraw Publishing Company. 1300 pages; 1300 Company. 300 pages. Price, $2.50.

A complete review of a book of this character would occupy more space than could be possibly devoted to the purpose, therefore we must confine ourselves to a general description of the book as a whole. The entire field of electrical engineering has been more completely covered in this book than in any similar book the writer has seen, not excepting those published in England, Germany, France and Italy. It is a book of which American engineers can well be proud. One of the most striking and satisfactory features is the method of treatment. The field is divided into 20 sections, each section being treated as a unit. The list of sections and authors is as follows: 1. Units, by Otis Allen Kenyon; 2. Electric and Magnetic Circuits, by Otis Allen Kenyon; 3. Measurements and Measuring Apparatus, by Otis Allen Kenyon; 4. Properties of Materials, by Otis Allen Kenyon; 5. Magnets, by Otis Allen Kenyon; 6. Transformers, by A. S. McAllister, Ph.D.; 7. Electric Generators, by H. M. Hobart and Otis Allen Kenyon; 8. Electric Motors, by A. S. McAllister, Ph.D.; 9. Batteries, by Edward Lyndon; 10. Central Stations, by R. C. Beardsley and George Shaad; 11. Transmission and Distribution, by Arthur Vaughan Abbott and Otis Allen Kenyon; 12. Illumination, by Louis Bell, Ph.D.; 13. Electric Traction, by A. H. Armstrong; 14. Electrochemistry, by E. F. Roeber, Ph.D.; 15. Telephony, by Kempster B. Miller; 16. Telegraphy, by Otis Allen Kenyon; 17. Miscellaneous Applications of Electricity, by Otis Allen Kenyon; 18. Wiring, by William H. Onken; 19. Standardization Rules; 20. Tables and Statistics.

The order of arrangement seems to be: Principles, theory, apparatus, generation, transmission, distribution and utilization. This scheme is carried out in the arrangement of the sections with reference to one another. Each section in itself forms a complete, but condensed, treatise of the subjects covered by its title. This arrangement is logical and notably free from repetition, frequent use of cross-references being made.

There are many novel features embodied in this work, but the most notable departure from usual practice is the method of indexing. The paragraphs of each section are separately numbered, and the paragraph and section numbers are set at the head of the page. Index references are made to section and paragraph numbers. This method has the advantage of taking one closer to the item of which one is in search. If equipped with a thumb index to the sections, this system would be ideal. Although the publishers have made a great improvement by adopting this system, it is hoped that the next edition will be equipped with a thumb index.

It is a pleasure to note that a uniform system of symbols and abbreviations is used throughout the book, and also that one is not referred to a key, but finds the meaning given with each formula and equation.

The extensive use of curves for presenting data is to be commended. The graphical method has several distinct advantages: it reveals the law which governs the phenomena, it condenses the space into which a given amount of information can be put, and it gives data for any set of conditions without interpolation.

It is impracticable to discuss the contents of each section separately. However, special mention should be made of the sections on Transformers, Generators, Motors, Traction and Electrochemistry. These sections are especially valuable, since they fill gaps in the existing literature on these respective subjects, and any one of them would be welcomed as a separate book.

The preparation of a work like this is a giant undertaking, and when one has finished a thorough examination of this book, it seems little short of marvelous that such an immense amount of material written by so many eminent and busy men could be obtained, carefully edited, indexed, illustrated and co-ordinated in a single volume. The up-to-dateness is quite puzzling, there being references and quotations from articles which appeared as late as a few weeks before the publication of the book.

The book work is first-class, especially the binding and paper. The illustrations are sometimes a trifle small, but the character of the book justifies this economy in use of space.

It is safe to say that the book will soon make a reputation for itself which can be compared only with that at present enjoyed by the "Ingenieurs Taschenbuch," published by the Hütte, in Germany. It should be valuable to students of electrical engineering, as well as to practicing engineers, and will probably be used in a great many colleges as a text-book.

Dimmers for Domestic Electric Lighting.

BY CHARLES WIRT.

Although contrary statements have been made, the writer believes the first theatre to be electrically lighted was the Academy, in Halsted Street, Chicago, in which were installed 150 Edison lamps in 1882. No stage lamps were used owing to the fact that dimmers or electric regulators had not at that time been designed. The first dimmers which the writer remembers as applied to stage work were rheostats constructed with galvanized wire resistors and having five steps. A sunset effect in five jumps is something which needs to be seen to be appreciated.

The improvement shown in the evolution of electric light regulation adapted to the exacting requirements of artistic stage work—the contrast between the crude results exhibited in 1883 and the years succeeding, and the fine work which may at present be seen nightly in any first-class theater—is equal to that shown in the same time by other branches of the art of illumination.

While the demands of artistic stage work have been met in the perfect control afforded by the modern theatre dimmer, little has been done in the way of perfecting the incandescent lamp for all household requirements.

One of the many accessories designed by Edison was an incandescent lamp stand permitting of graduation of the light. This comprised a wooden base, supporting a vertical brass cylinder with a 16-cp lamp at the top. This cylinder contained parallel rods of Carré carbon of small section, which were joined into circuit by turning the cylinder. The dimming effect was very good, but the device was expensive and cumbersome.

While installing incandescent lamps at the Milwaukee County Hospital, in 1884, a positive demand was made for turn-down lamps. This demand was met by a small, cheap rheostat construction having five or six steps, each adapted to control a single lamp, the rheostats being placed upon the wall near each lamp.

A "lamp regulating switch" for one lamp was listed by the electrical trade in 1892, and many were sold. However, the expense of this device was out of proportion to the effect, and the plan would probably not be acceptable to the fire underwriters to-day.

For night lamps a series and parallel attachment has been sold, adapted to connect two ordinary lamps into series or parallel; this plan has been applied in bedroom lighting quite successfully. The best arrangement comprises a special switch operated by a flexible cord in order to be worked from the bed.

The Patent Office shows a great many devices of the "two filament" class, the best known of these being the Hylo lamp, which is almost universally used, at least in the United States. Many lamps of this class have been placed on the market, some of which are very little known.

Although the two-filament turn-down lamp is simple and cheap, and sometimes quite satisfactory, it does not meet the condition so often quoted of "An electric light which will turn up and down like gas." There have been produced a great many designs of regulators intended to be directly applied to the lamp. Generally these have been made in the form of a socket containing reactance or resistance controlling devices. The Ries regulating socket, of Elias E. Ries, of Baltimore, which is intended for alternating currents, contains an iron core with winding subdivided into steps and operated by the socket key. This article is quite familiar, although not in large use, probably owing to the rather expensive construction involved.

Of the rheostat or resistance sockets, the Brunt is a good representative, comprising a very well made ventilated rheostat having a perforated brass shell, and a resistor in sections wound on porcelain. No fault can be found with this device. It is large for the work to be done, and apparently not cheap in construction. It has performed excellent service. Later specimens of this form of regulating socket are in the market, and are used for controlling small motors, as well as in connection with incandescent lamps.

It is a fact not immediately apparent that while the ventilated rheostat is perhaps the best form for heavy work, it does not give the simplest construction nor the smallest possible size. The heat generated is dissipated both by convection and by radiation, but at low temperatures under usual conditions convection is ineffective. Small rheostats or heaters working at moderate temperatures lose the greater amount of heat by radiation. Surrounding a rheostat or a heater of this description by a perforated shield accomplishes only one object; the perforated shield acts as a guard and does not get as hot as the interior, but its presence increases the interior temperature and decreases the effectiveness both of radiation and convection. Wherever the temperature is moderate, better results are obtained on small rheostats by bringing the heating element into good contact with the atmosphere.

Evolution shows this plainly in the case of small field-circuit rheostats, in which the ventilated type has largely disappeared.

and, as a result, sizes have been reduced somewhat and the cost reduced greatly.

Fig. 1 shows an exterior view, and Fig. 2 a section of a form of rheostat socket which is being manufactured by Charles Wirt & Company, and which is adapted to be used with an ordinary 8-cp or 16-cp incandescent lamp, or with lamps of the tantalum or tungsten class consuming from 20 to 60 watts.

The resistor drum of the "Dim-A-Lite," as it is called, is only 1½ ins. in diameter and 1 in. long. It contains a resistor coil of zero temperature-resistance coefficient wire, molded under pressure in a stone-like insulating composition called Di-el-ite.

The commutator bars, which serve to make contact when the cylinder is rotated, can be seen in Fig. 2. This resistor being molded into a steel shell, which is entirely filled with the insulating stone parts, will heat readily and the wire is well protected.

By properly porportioning the resistance steps it is possible to control a 50-watt lamp by a rheostat of this small size with a rise of temperature at the surface of not more than 120 deg. F. (66 deg. C.).

Control is had by rotating the resistor cylinder by means of a "pull string," for which purpose a linen fish line serves perfectly. The first dimalites were made with flexible chain, on account of the anticipated heat effect upon the cord, but the chain was found to be expensive and unnecessary.

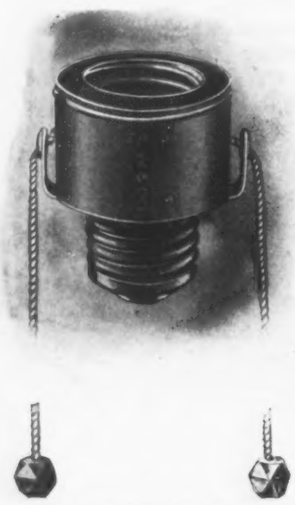


FIG. 1.—DIMALITE LAMP RESISTOR.

FIG. 2.—PART SECTION OF RESISTOR.

The useful grades of lighting for ordinary domestic use, including nurseries, is found to be, according to the experience of a large number of users, a two-candle step for softened illumination. This amount of light in a room of ordinary size, whether a bedroom or drawing-room, is ample for general illumination, and one or two additional steps, giving extremely low candle-power, in fact, too low to be measured. A good practical specification of the lowest step is "light enough to read a clock dial close to the lamp." The use of an insulating cord, keeping the hands away from the socket, is thought to give a certain measure of safety against the possibility of shock. Although it is rather rare to get a serious shock from lamp fittings in proximity to bathroom fixtures, the danger is worth considering.

The scepticism of people in general, and also some electricians, regarding economy in consumption of energy by the use of resistance regulation is rather remarkable. Only 100 per cent of the lamp resistance in series with the lamp is needed to reduce the amperes to one-half, and since the total voltage is the same, the power and energy are reduced by 50 per cent, and the meter reading is decreased by that amount. Although the problem is a very simple one it seems to puzzle some men who are otherwise familiar with electrical arithmetic.

To meet all requirements from 200 to 300 per cent of the lamp resistance is needed in the dimalite, requiring a current when "all in" of one-third or one-quarter the full value. At one-quarter normal current a 16-cp, 50-watt carbon-filament lamp will consume about four watts (at the lamp) while the resistor will consume about nine. The candle-power will be too low to measure by an ordinary standard photometer, but there will be light enough to read a clock or watch close to the lamp.

The writer feels certain that in future lighting of homes graduation will be insisted upon. The advent of lamps of less consumption than three watts per candle will favor the use of resistance graduation. The conditions can now be met fairly well even with a three-watt lamp. With better lamps it will be very easy to give perfect control of each lamp, and as there will be less power to deal with the economy will be more satisfactory. It is necessary merely to examine the rooms of a house lighted with gas and note the varying degrees of light at each separate jet to realize how much is lost with incandescent lighting when one is unable to do anything of the sort in the case of the better lighting agent.

Commercial Testing of Watt-Hour Meters.

By W. C. Andrews.

Accurate periodic testing of their customers' meters has been an established policy of lighting companies for many years. The almost universal system of metering the energy used by the individual consumer has brought a recognition of the value of inspection at regular intervals not only to prevent lost revenue from inaccurate meters, but to maintain a positive up-to-date record of the meters' performance. Most central station managers look upon their meter-cards as an important asset, on account of their usefulness in settling disputes over lighting bills. The major portion of the company's income is based on the meter readings, and arguments are at times unavoidable, but many a discontented customer has been completely satisfied by an inspection of his meter's history. The indisputable evidence that the management knows what it is talking about produces a moral effect on the customer that can be accomplished in no other way, and thus strengthens greatly the standing of the company.

The value of the tests depends largely on two characteristics, accuracy and rapidity, accuracy maintained under existing conditions of operation and observation is of paramount importance in all testing work, and rapidity enables the meter cards to be kept up to date without undue expense. The apparatus, furthermore, should be compact and suitably arranged for safe transportation, it should be low in first cost and maintenance, and should be simple in construction and operation. Development along these lines has produced many methods of meter up-keep.

The practice of replacing, periodically, customers' meters with new ones, fresh from the testing room of the illuminating company, was early discarded on account of its expense, both in labor and extra equipment, and of the loss of confidence produced on the customer. The testing and adjustment of meters on the customers' premises was then tried and originally made by what were practically laboratory methods. As the watt-hour meters could not be brought to the laboratory, the laboratory watt meters, stop watches, lamp banks, wires, switches, etc., were carried from house to house by the inspector and as many assistants as were necessary. Many objectionable features outside of the expense and inconvenience were found in this method; accurate determinations necessitated a correct averaging of all the readings of the indicating instruments during the period of test, which was hardly practicable under ordinary fluctuations of load or voltage; observations were often difficult on account of poor light, etc., the stop watches were seldom reliable, and the calculation of the results was complicated and liable to inaccuracies.

The laboratory instruments suffered from the necessarily rough usage and continuous handling, and their repair was expensive. Furthermore, the number of instruments required to

test the meters accurately at different loads made the outfit costly and cumbersome.

A makeshift intended to cheapen the work was found in the so-called "constant-load" method. A bank of "standard" lamps was generally employed, and a voltmeter and stop-watch were necessary. To the other possibilities of error, therefore, was added the variation in resistance of the lamps, and this method was little used.

In a paper read before the Association of Edison Illuminating Companies, in 1902, Mr. W. J. Mowbray, of the Brooklyn Edison Company, described a great advance in the art of watt-hour meter testing and a system upon which the present most approved methods are based. Mr. Mowbray used a modification of a Thomson watt-hour meter, in which the usual dial was omitted, and the revolutions of the disc were compared with the revolutions of the disc of the meter under test. Special series coils were also provided for testing at different loads, making a very wide range with no light-load errors.

This method of testing has been in constant use by a large number of companies for several years. With recent improvements in the apparatus, of which a practical form is shown in the accompanying illustration, an excellent system for periodical meter inspection has been developed.

The portable standard test energy meter shown has a negligible error for variations in frequency, voltage, load or temperature. That is, no matter what the conditions are during test, within ordinary commercial fluctuations or changes, the results show the operation of the meter being tested under those conditions, and one standard may be used to test watt-hour meters of different makes and characteristics. It is absolutely necessary for satisfactory tests that definite results at the time of making the test be obtained—if the voltage, frequency, etc., are abnormal, these results may be reduced to the probable operation under other conditions by applying the proper correction factor for the meter under test, but in all cases the standard should be accurate and determine the exact performance of the meter under test.

FIG. 1.—PORTABLE STANDARD FOR TESTING WATT-HOUR METERS.

The test meter consists of a high torque induction energy meter with the ordinary combination of braking magnets and motor elements, but with the usual vertical register replaced by a horizontal one at the top of the meter frame. The disc shaft passes through the center of this dial and carries a pointer which shows directly the revolutions of the disc. The auxiliary small dials, within the large one, have pointers indicating tens and hundreds of revolutions, and the large dial is divided into hundredths, so that 1 per cent of a complete revolution may be observed. Three series coils are used which in ordinary standard meters are for 1, 10 and 20 amperes, respectively, as being most suitable for testing the average types of meters on customers' premises, ranging in rating from 3 to 25 amperes.

The 1-ampere coil gives extremely accurate results on light loads. With, say, one lamp, the load on the standard will be approximately 50 per cent of the rating of the coil used, and the accuracy will be practically the same as at full load. If the 1-ampere coil were omitted, the light load accuracy would have to be very carefully maintained in order to give reliable readings within the limits of observation provided by the large, easily-read, registering hand. The coils are so wound and calibrated that the same percentage of full load on each produces the same torque on the disc, and hence the same accuracy. One terminal of each coil is connected to a common binding post at the top of the meter, and a separate binding post is used for the other end. This makes the most convenient and reliable method of changing the rating of the meter, as one flexible series lead alone has to be moved. The shunt coil of the motor element terminates in a plug receptacle, also on the top plate. In this particular make of test energy meter the friction is reduced to a very small value by careful workmanship, the register staffs being made of highly polished steel and the gearing accurately cut and polished, while a cup diamond jewel is used for the lower bearing of the meter shaft supporting the disc.

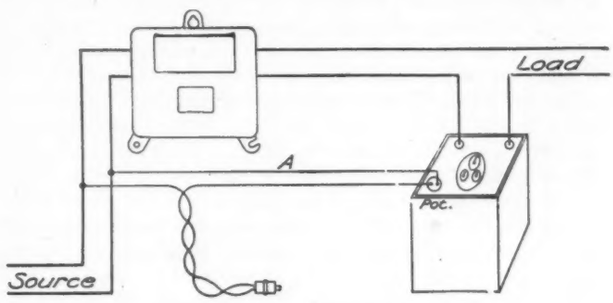


FIG. 2.—CONNECTIONS OF TEST METER IN USE.

The test energy meter is enclosed in a wooden carrying case with cover and strap, suitable for convenient transportation. A small thumb nut near the dial is connected to a locking device, which raises the moving element from its jewel bearing, and holds it safely during any shocks or jars to the case.

In use, the series coils are simply connected between the load and the meter under test, and the shunt coils are connected by means of a lamp cord to the service wires. This connection prevents either meter registering the energy taken by the shunt coil of the other, and so avoids an appreciable error on light loads. A pendant snap switch is inserted in one side of the potential circuit of the standard for conveniently starting and stopping it. The operator observes the dial reading of the standard before starting a test. The revolutions of the meter under test are

FIG. 3.—MECHANISM OF STANDARD TEST ENERGY METER.

observed by watching a spot on the disc as it passes the calibrating window. The pendant switch is closed just as the first counted revolution of the meter under test begins, thus starting the standard, and a given number of revolutions are then counted on the meter under test. As the last revolution is completed the pendant switch is opened, which stops the standard, and the dial reading is noted. The difference between the readings of the standard at the beginning and the end of the test gives the number of revolutions of the standard's disc, so that the only observation during the test is the counting of the revolutions of the disc of the meter under test, and one operator can conduct the entire operation. When the meters have the same constants, that is, when the same load should produce one revolution of the disc in a given time, a direct comparison of the numbers of revolutions made by the two discs will indicate the accuracy of the meter under test. If the constants of the meters are different, as is generally the case, it is merely necessary to reduce the numbers of revolutions to the corresponding watt-hours by multiplying the constant by the number of revolutions, and then to compare the number of watt-hours.

The elimination of the light-load errors by interchangeable series coils gives the method a decided advantage over the use of wattmeters. With the latter, even if the indications are correct on the lower end of the scale, the graduations are generally so small at that point that an error no greater than the width of the needle will often change the results obtained by several per cent. To avoid these errors, several watt-meters must be carried around, and the standards continually interchanged during the tests, a method not only inconvenient, but prone to inaccuracy.

Another familiar and prolific source of error that is removed is the stop-watch with the constant attention and repair necessary to give even moderate reliability.

It is important that the portable standard energy meter be correct; its accuracy should be maintained, therefore, by periodical checking and adjustment against laboratory wattmeters or watt-hour meters of known reliability. A feature of the portable standard illustrated is the ease with which it may be calibrated. The full-load adjustment is obtained by moving the brake magnets toward or away from the center of the disc as it is desired to increase or decrease the speed of rotation. Shifting a small rectangular conductor situated between the disc and the potential winding distorts the flux and changes the light-load adjustment of the meter without affecting the calibration at full-load.

The connections, as shown, are simple, the calculation of the results takes only a moment with little chance for clerical mistakes, and the duration of the test is never more than a few minutes. Rapidity, one of the essential features is, therefore, obtained at no sacrifice in the accuracy of results.

An Accumulator with Boxed Active Material.

The Standard cell is the first commercial storage battery to break away from the traditions of accumulator construction as it provides an electrode in which the active material is actually boxed up and so held in contact with its lead backing that buckling is impossible and no disintegration can occur. The result is a cell which has all the good qualities of the ordinary lead accumulator and is practically indestructible under service conditions. A single plate of the Standard cell is composed of a lead conducting plate sandwiched between two layers of active material, held permanently in place by very porous earthenware plates. These plates, of which the inner surfaces are reticulated to grip the active material, and the outer surfaces ribbed for strength and to furnish flues for the circulation of the electrolyte, as shown in Figs. 1 and 2, form a thin tight box about the conducting plate which absolutely prevents the escape of the active material. The plates are so porous as to offer no material obstruction to electrolytic action while preventing completely loosening, escape, or infiltration of the active material.

The result is a cell identical chemically with other lead-lead-oxide cells, but very light for its rating on account of the absence of heavy retaining grids, and free from all the usual causes of deterioration. Cells of this type in use for as much as five years are still in as good condition as when first put together and apparently are good for many years more of regular service. Cells of 100-ampere hours rating sealed in

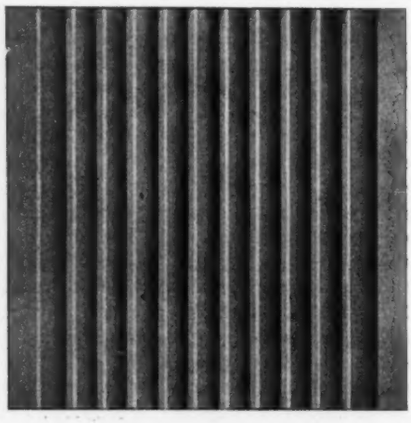


Fig. 1.—PLATE OF STANDARD ACCUMULATOR.

rubber jars complete with electrolyte can be brought down to a scant 20 lbs. in weight without difficulty or increased risk of deterioration.

The unit system is employed in the Standard construction, the individual plates being about 2½ ins. square. In building up elements, as many of these as are necessary to secure the desired output are assembled about a common conducting plate, thus forming a single large plate of whatever proportions are expedient and of these composite plates as many as are needed are built up and clamped together to form the element. This construction gives a considerable choice as to the relative proportions of the larger elements, which is sometimes very convenient.

Repeated tests of Standard cells have shown excellent efficiency and the same immunity from deterioration in practice that would be expected from theory. Even severe short-circuiting does no permanent damage and the cell thus treated can promptly be brought back to its full capacity.

One considerable advantage of the Standard construction

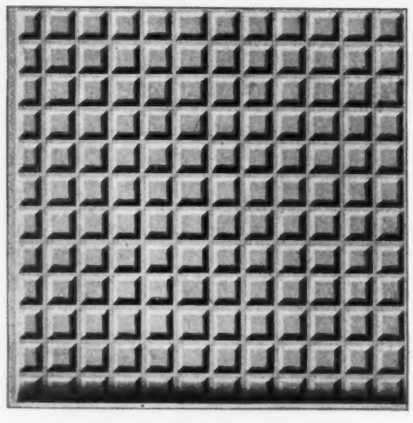


FIG. 2.—PLATE OF STANDARD ACCUMULATOR.

is that the active material can be disposed in a thin layer without fear of disintegration, which promotes uniform chemical action and lessens the chance of forming local circuits. Thick plugs of active material as found in ordinary gridded plates are liable to inequalities of electrolytic action which both injure the efficience and promote disintegration. In fact, the Standard plates when examined after long use show the active material remarkably coherent and homogeneous with no signs

of local action. The Standard accumulator is manufactured in all the usual sizes and put up in sealed rubber jars, glass cells or lead-lined wooden tanks as occasion demands; and the unit system of construction makes it easy to develop cells of special weights or capacities. This battery is made by the Standard Electric Accumulator Company, 141 Broadway, New York City.

Artistic Outdoor Lighting Fixtures.

BY C. L. ESHLEMAN.

When it is considered that during the year 1906 the sale of arc and incandescent lighting apparatus in the United States aggregated approximately $12,000,000, the great importance of this particular branch of the electrical industry can be fully appreciated. The above figures cover only the lamps and closely related apparatus, and do not include the many millions expended for boilers, engines, turbines and other devices required to furnish the necessary power to produce the light.

As we follow the development of arc and incandescent lamps we note that most manufacturers in their eagerness to produce an article possessing higher efficiency and greater mechanical strength, have overlooked artistic qualities. A radical change, however, has taken place within the last five years, and to-day

CONCRETE ELECTRIC LIGHT POST.

illuminating engineers are spending their entire time and exerting every effort to plan installations in which the æsthetic as well as practical taste is satisfied.

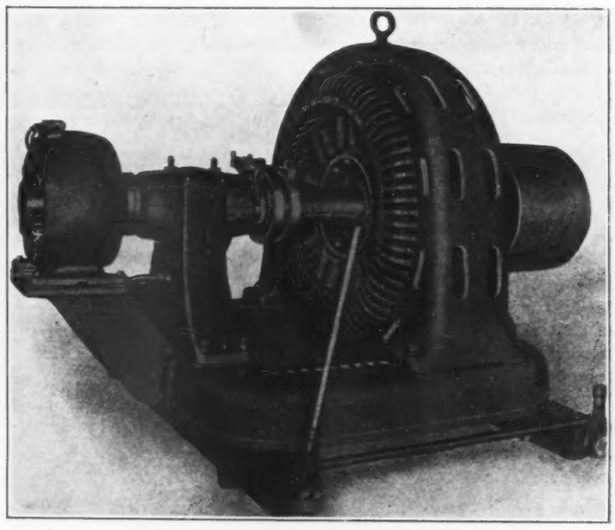
The need of artistic street lighting was early appreciated by Mr. W. E. Daniels, of the South Park Commissioners, Chicago, Ill., whose position gave him an excellent opportunity to study all phases of outdoor illumination, the result of which study was the invention and patenting of the Daniels system of boulevard lighting. The manufacture and exploitation of this system has been undertaken by the Jandus Electric Company, of Cleveland, Ohio.

As indicated by the accompanying illustration, the fixture consists of a rectangular base, reinforced concrete post of Colonial design, covered by an Ionic capital and the whole surmounted by a 20-in. opal ball globe, contained within which is a complete arc-lamp mechanism. The system has been designed to operate on either multiple direct current or series alternating current, and is, therefore, specially adapted for use, either in city business quarters, where direct current is usually furnished, or in residence and outlying districts, where alternating current service is in use. During the development of this system exhaustive experiments were made with both steel and concrete posts, but concrete construction seemed so admirably adapted to this particular service that it was finally decided to eliminate steel entirely. The concrete post can be molded and finished to correspond to sandstone, marble and granite; in fact, any natural stone or marble finish, ranging in color from dark gray to pure white. These posts are practically indestructible and are much more attractive than painted steel goose-neck designs. They will not oxidize; and it is stated that the cost is so reasonable that the system may be applied economically to ordinary street lighting. The lighting of boulevards and parks, public squares, public buildings, capitol grounds, business blocks and numerous other applications fall within the sphere of the "Boulevard lamp."

Belted Alternators.

In its line of belt-driven alternators, the Electric Machinery Company, Minneapolis, Minn., has paid particular attention to ventilation. Upon the ventilation depends the temperature rise of the machine, and, hence, the life of the insulation. Moreover, for a certain limiting temperature rise, the least constructive material is required when the ventilation is properly arranged. It is seen, therefore, that both the initial cost and the cost for replacement are closely related to ventilation.

In the machine illustrated herewith the revolving field-core has vents at intervals in the pole-pieces which admit cool air from near the shaft, up through the pole-piece inside of the



BELTED ALTERNATOR.

field coil. The vents register with vents in the armature core, which are formed by corrugated spacers which obstruct the air only very slightly. The cooling air currents easily find their way out of the frame through the many openings, and carry off the heat that is generated in the windings and core. The tooth supports at the ends of the armature core are also open and afford a good opportunity for air to sweep by the ends of the cores and between the armature coils. The coils do not lie close to each other, but are open like a grate and permit air to pass through on all sides of each coil, so that no local heating results.

The field-coils are excited by a 125-volt exciter, directly driven by the alternator shaft, as shown. The exciter may be belt driven if desired.

The machine, it is stated, runs quietly under all loads, the design of the armature teeth, pole tips and air gap being carried out with that object in view. This alternator may be run in either direction.

It is stated that the temperature rise after a 10-hour run at full non-inductive load does not exceed 25 deg. C. in any part of the machine above surrounding air, and with 25 per cent overload following the above run the additional rise does not exceed 10 deg. C. With inductive load, the temperature rise is slightly higher in the field coils, but about the same in the other parts.

On account of the distribution selected for the constant and variable losses, the efficiency of this line of alternators is nearly uniform over a range of load from one-third load to 25 per cent overload. This efficiency is high, due to liberal proportions of both copper and iron sections. An alternator rarely works for long periods at full-load, and it is, therefore, very important that it give a good efficiency over quite a wide range of load. It is claimed that the rise of voltage when the load is thrown off is very small, not exceeding 8 per cent on non-inductive load, even with the smallest size of machine, and being not over 6 per cent in larger machines.

Turbo-Alternators.

The accompanying illustrations show the constructive features of Allis-Chalmers alternators designed for direct coupling to steam turbines. Fig. 1 illustrates a revolving field core before being wound, while Fig. 2 shows a complete rotor for a 1500-kw turbo-alternator. The field cores are according to size and conditions, built up either of steel laminations or of nickel steel forgings, of high magnetic permeability and great physical strength. The slots formed in the core to receive the field coils are radial, the field winding being flat strap copper. The method of winding flat strap in radial slots has been made possible by a specially designed forming machine which bends the copper edgewise and gives an increasing spread to each successive turn of the coil. The carefully insulated coils are firmly held in the slots by means of Parsons manganese-bronze wedges. The completed rotor is thus formed as a smooth surface cylinder, no matter what the number of the poles, thereby reducing the windage loss, besides tending to quiet operation.

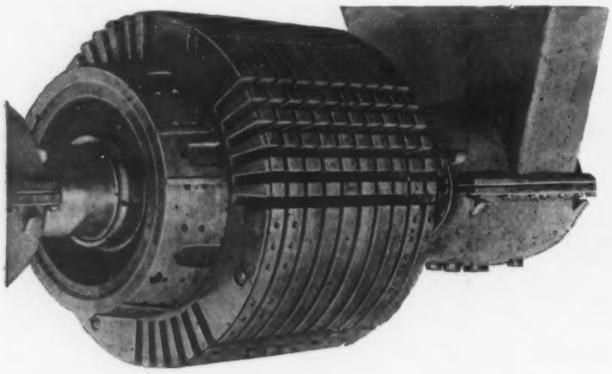


FIG. 1.—REVOLVING FIELD CORE READY FOR WINDING.

Ample spaces are allowed at regular intervals between the laminations, or discs of the core, to provide for ventilation of the core itself and of the coils, air being drawn in through openings formed parallel with the axis and discharged at the periphery. The ventilation of the ends of the coils is attained by allowing them to project beyond the ends of the core in such a way that they can be thoroughly cooled; the coils at this point being firmly secured against the effect of centrifugal force by means of nickel-steel rings, which form an extension of the core, and are provided with openings for the passage of the cooling air current.

Fig. 3 shows the stationary armature with the coils in place. Every precaution is taken to secure thorough ventilation, so as to prevent excessive temperature of the armature core and winding. The laminated core is provided with numerous air ducts, and the frame is so formed as to assist in the circulation of air.

The armature coils are all completely formed in the shop so that no connections have to be made after they are placed in the armature core at the purchaser's station, except the connections of the coil terminals, thus reducing to a minimum the risk of defective insulation at joints. The advantage of this will be appreciated by station operators, especially for high-voltage work.

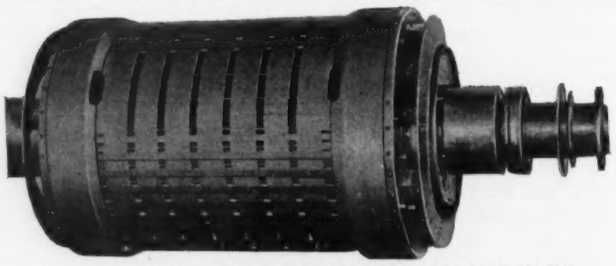


FIG. 2.—COMPLETE ROTOR FOR A 1500-KW TURBO-ALTERNATOR.

Care is taken in the insulation of the coils by successive dippings and bakings after the application of the various layers of insulation. The coils are firmly secured in the slots, and particular attention has been paid to the form of the coil-ends and the securing of them in such a way as to prevent deformation in case of a short-circuit.

For the purpose of obtaining adequate ventilation and for muffling the noise produced by the circulation of the air, these turbo-generators are enclosed in such a manner that the air is taken in at the sides of the machine, passing through fans which discharge it over the end connections of the armature coils into the bottom of the machine, whence it passes through the ventilating ducts of the core to an opening at the top.

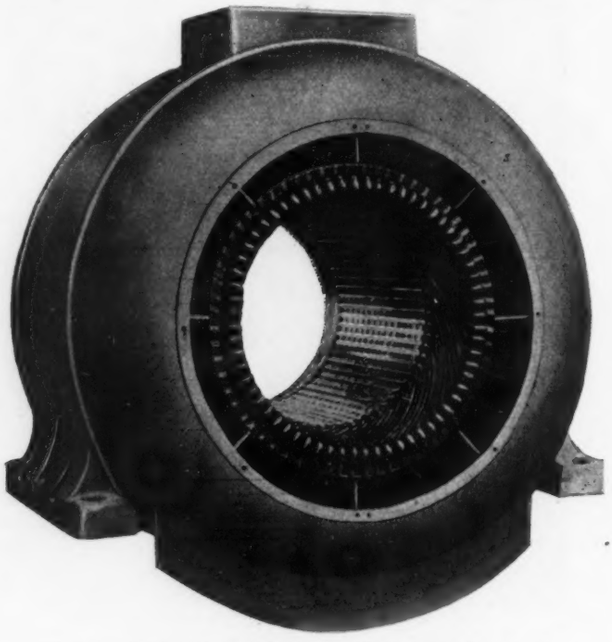


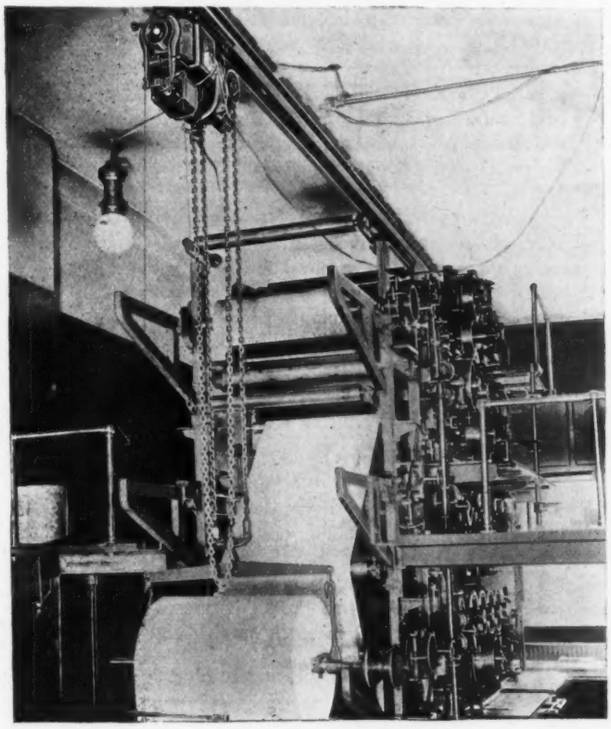
FIG. 3.—STATIONARY ARMATURE WITH COILS IN PLACE.

Electric Paper Hoists.

In large printing plants the transfer of the paper from the storage rack to the press is a task which yearly has become more and more arduous to the pressman. In years gone by the paper was easily transferred by hand, but as the size and weight of the paper increased, chain blocks were installed to do the work. At present, with the greatly increased demands made upon large printing plants, especially those devoted to newspaper work, the chain blocks are as inadequate as were the manual methods of former years, being slow and not easily operated. Electric hoists, on the other hand, are quickly and easily

operated, and are particularly well adapted for the purpose. They are now used in many press rooms throughout the country.

The accompanying illustration shows an electric paper hoist, recently installed in the printing plant of the Pittsburg *Gazette-Times,* at Pittsburg, Pa. This is a two-chain hoist, operated



ELECTRIC PAPER HOIST.

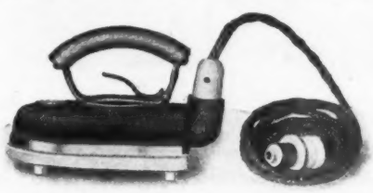
by a 3-hp, 115-volt, direct-current enclosed series motor. It is capable of lifting 4000 lbs. on the hook at a speed of 10 ft. per minute; the maximum height of lift is 15 ft.

This hoist is operated from the floor by pendant ropes which connect with a single-speed controller mounted on the trolley carriage. It is fitted with a mechanical brake.

The Sprague Electric Company, 527-531 West Thirty-Fourth Street, New York, manufactures these electric paper hoists for operation on 115, 230 or 500-volt direct-current circuits, and for lifting from 1000 lbs. to 6000 lbs.

Economy Electric Flatiron.

The electrical department of the Art Machine Company, of Brooklyn, N. Y., manufacturer of electric heating appliances, has brought out an electric flatiron said to possess many valuable points of merit. The heater is constructed according to a



ELECTRICALLY-HEATED FLATIRON.

patented principle whereby the heat is produced at the bottom of the iron. The internal electric heater covers the bottom of the iron, thus heating its entire surface. The irons are fitted with a removable hardwood handle, and being always cold, no protecting pad is needed. Each iron is furnished with 8 ft. of flexible, fireproof, approved cord, with a separable plug at each end, one to screw into a standard socket and the other on the flatiron. The asbestos stand, which is part of the equipment, is a very strong, fireproof and heat resisting device having the appearance of marble and mounted on four supports. The irons are made in a variety of shapes and weights suitable for traveling, sewing room, family and laundry use.

Boiler Flue Plug.

The accompanying illustrations show the application of the Betterman standard boiler flue plug, made by A. L. Smith & Company, of Philadelphia, Pa. The plug consists of two caps with gaskets and nuts, which are held in place by an iron rod threaded for a nut at each end.

It is very plain to be seen that in placing or removing this plug the flue sheet is subject to no strain or other injury which very frequently happens in the use of temporary expedients and devices usually resorted to when flues leak. The simplicity of the plug, means of quick repair, ease of application, perfect

BOILER FLUE PLUGS.

adjustment, combined with high factor of efficacy and economy, commends it to all users of steam boilers, and to the best mechanical judgment. Any boiler may spring a leak at any moment, and however small the leak in connection with a tube there is necessity for instant repair. Risk is always incurred when leaks in tubes are not attended to, but repairs usually have necessitated shutting down, owing to the location of the plant, more or less annoyance, loss of time, trouble and expense in procuring the services of a boilermaker and material to replace the flue.

The size of the plugs correspond to standard tube measures. Plugs ranging in size for tubes 1 in. in diameter to 6 ins. are made.

Recording Milli-Volt Meter and Shunt Ammeter.

The accompanying illustrations show an accurate and sensitive recording milli-volt meter, which is adapted to practical every-day service, as well as for laboratory tests, and a recording ammeter of the shunt type which can be connected by leads to the main bus-bars. The shunt system is especially convenient where large values of current are to be indicated or recorded, because the instruments may be located at a considerable distance from the main circuit, thus eliminating the expense for extending the main conductors to the location of the instrument.

Two of the important fundamental features of the recorders are a sensitive electrical movement of special design, and a recording system using a smoked chart so arranged that there is absolutely no friction between the recording arm and the chart.

It is stated that the instruments are so sensitive that the recording arm will move over the whole scale for five millivolts or less, making it possible to record accurately one ten-thousandth of one volt. The graduations on the chart are evenly proportioned over the entire range so that even though the current is small in value the readings may be as readily taken as if the current was the maximum that the instrument would record. This feature is of value for use where it is desired to install instruments for increasing future demands, and it is important that the records be perfectly clear, even though the loads are very light when the outfit is first used.

The records are made on a semi-transparent smoked chart, which is periodically brought into momentary contact with the end of the recording arm by means of a special vibrating device. In this way a series of white dots are made on the

smoked surface, and these form a continuous line. The rate of vibration of the chart is timed to suit the frequency and range of the variation in the current to be recorded. The usual period of vibration of the chart is once in ten seconds, but to obtain

FIG. 1.—CHART OF RECORDING MILLI-VOLT METER.

continuous lines where the fluctuations of the current are quite rapid, the vibrating attachment may be made to operate twice every second. When the record is completed, the chart is dipped in a simple fixative solution which makes the record permanent for filing.

The recording shunt ammeter is shown in Fig. 2, and Fig. 1 is a reduced photographic facsimile of a chart taken from one of these instruments in connection with electrolysis surveys of underground structures which are being conducted by the Electrical Testing Laboratories, of New York City. The graduations of this chart are arbitrary. It was revolved once in 24 hours, and was vibrated once every ten seconds. The zero position of the recording arm was the middle of the scale, so that the record might be independent of the direction of the current, as in many cases the direction of the current changes from negative to positive during the day. It is expected that by using a number of these instruments operating simultaneously at different points, stray currents in water and gas mains, or in any underground structure, may be recorded, making it possible to discover the causes of trouble and to devise a method for their elimination.

The recording ammeter, shown in Fig. 2, is connected to a standard 10,000-ampere shunt, to which is also connected an indicating station ammeter. The recorder may be readily applied to any standard shunt which is already in service without disturbing the indicating instrument at the swtchboard. As illustrated here, leads of almost any desired length may be used to connect the indicating and recording instruments to the shunt on the main bus-bar. It is even possible to have the recording ammeter located in the superintendent's office at a great distance from the shunt, and the indicating instrument located on the switchboard convenient for the observation of the operator.

For preliminary tests, the recorders are provided with special fast vibrators for the smoked chart and with a clock movement to revolve the chart once in one hour, but for continuous daily records, the standard 24-hour charts are recommended.

These instruments are manufactured by Wm. H. Bristol, 45 Vesey Street, New York City.

Window Reflectors.

The National X-Ray Reflector Company of Chicago is planning important new developments in the reflector line for 1908. Since February, 1906, when the "Poke Bonnet" reflector, as a substitute for the single trough reflector for show windows, was brought out, over 40,000 have been sold. From the dealers' and contractors' standpoint, this reflector is popular because each reflector, containing two lamps, is a complete unit in itself, which can be carried in stock so that the dealer or contractor does not have to wait for a trough to be made to order of the proper length, as in the case of the single window trough reflector. From the user's standpoint, it is popular because of the high character of its reflecting surface and its slower rate of depreciation than common mirrors. Besides having an advantage in this respect, it utilizes some light which is wasted in common forms of troughs by efficiently reflecting the light given off in the direction of the lamp tip, rather than allowing it to be lost by absorption against the sockets of adjoining lamps. The "Poke Bonnet" is adapted for deep windows where the reflectors are not placed at a great height above the window. The "Helmet" reflector, recently brought out, is intended for

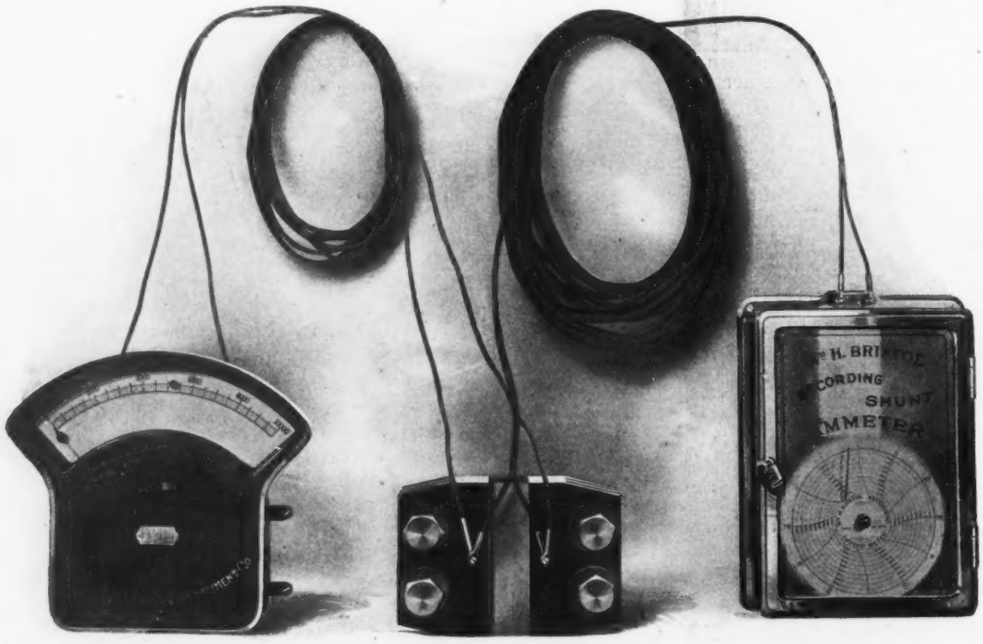


FIG. 2.—INDICATING AND RECORDING AMMETERS CONNECTED TO A COMMON SHUNT-BLOCK.

that large class of windows which are high and shallow, or where the show window proper is shallow and the lamps are placed at the ceiling considerably above the window. These are conditions calling for a concentrating reflector. The "Helmet" is a very powerful concentrator intended to use 125-watt Gem lamps or tungsten lamps of the same size. It is, in fact, the first window reflector adapted especially to the new high-efficiency tungsten lamps, since the lamp is used in a vertical position, and the proper distribution of light to give uniform illumination on the goods is obtained by the peculiar symmetrical shape of the reflector. Several very large stores with high windows have ordered these reflectors.

A New Separable Wireless Cluster.

The Benjamin Electric Manufacturing Company, 42 West Jackson Boulevard, Chicago, has just made some interesting improvements in its wireless clusters for multiple use. These improvements make it possible to remove completely the outer shell, together with shade holders and glassware, without disturbing the wiring. On clusters as heretofore constructed this has not been possible, and it has consequently been necessary to clean the reflector which surmounts the cluster without taking it down. With prismatic reflectors it was difficult to thoroughly clean the angles of the prisms without taking the reflector down, and consequently they were frequently allowed to collect much more dirt than was consistent with either appearance or efficiency.

Fig. 1 shows one of these new clusters disassembled. The porcelain base, which is the middle of the three parts shown in Fig. 1, is screwed onto the fixture or fastened against the ceiling. The wires are connected to binding posts on this base. The lower shell is then slipped over the base and given a turn which fastens it with a bayonet catch arrangement. One type of base is used for all clusters having a bottom lamp (such

FIG. 1.—WIRELESS CLUSTER DISASSEMBLED.

as shown in Fig. 1) up to a seven-lamp cluster, while another type is used for all clusters without a bottom lamp (such as shown in Fig. 2) up to a six-lamp cluster. The base carrying the bottom lamp is applicable to all clusters of from three to seven lamps, which saves complications in carrying a stock. After the base is once wired up in place the number of lamps can be increased or reduced. The type of base which carries a bottom stocket has three binding posts, so that the lamp in the bottom socket can be lighted alone if desired, or all lamps but the bottom one can be lighted. This porcelain base is only 2¼ ins. in diameter, being purposely made as small as this so that a reflector made for a 3¼-in. shade holder will pass the base through the neck. Such reflectors can, therefore, be taken down from above such a base.

The lamp receptacles on the cluster shell have a bead like a common standard socket, so that they will take any standard shade holder, and a special holder is not required for the cluster as heretofore. If it is not desired to use reflectors on the cluster, ornamentation can be added, as in Fig. 3, by putting on stamped metal husks, which are made by the same company, to slip over the bead on the socket shell. The cluster shell is made so that it can form the bottom half of a standard

FIGS. 2 AND 3.—WIRELESS CLUSTERS.

4-in. chandelier ball. This was done so that a cluster of this kind can be used on a combination gas and electric fixture. The cluster could then carry all the electric lamps on the bottom of the chandelier, and there would be no need of wiring the chandelier arms, thus reducing cost and complication.

Electric Heating Specialties.

The Vulcan Electric Heating Company, Chicago, announces for 1908 two important additions to its product. The first is an electrically self-heated, self-regulated curling iron, with a cord and plug attachment fitting any lamp socket. It has a continuous and uniform heat, and, therefore, accelerates the work of hairdressing and saves a great deal of time consumed with

FIG. 1.—CURLING IRON IN USE.

non-electric irons. The iron has a swivel cord attachment which allows perfect freedom in its manipulation. The utensil is adapted to both curling and "marcelling."

The other device is the toaster shown in Fig. 2. It is one of the small electric energy consuming devices that allow electric service to obtain a firm foothold for domestic application. The

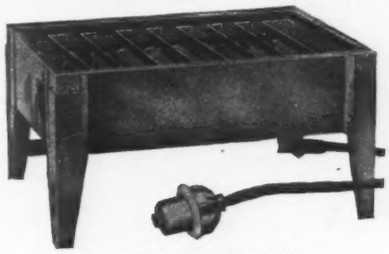


FIG. 2.—ELECTRIC BREAD TOASTER.

toaster here shown is designed for hotel and restaurant use, and it meets with immediate favor wherever introduced, because the toast obtained is unscorched by flame and untainted by gas. It can be placed in operation as readily as can any electric lamp, and is intended for attachment to a lamp socket. By its use bread can be toasted on the breakfast table, each slice being obtained crisp and hot as desired.

Polyphase Induction Motors.

In the type of induction motor illustrated in Fig. 1, special efforts have been made to obtain the maximum of ventilation, the minimum of iron loss and the least practicable wear in the bearings.

The scheme for ventilation follows somewhat after the usual arrangement found in direct-current apparatus. The iron on the outside of the primary laminations is open to the air so that the maximum amount of radiating surface is directly exposed. Large openings along the shaft give the rotor iron ample radiating surface. The coils are well distributed and are so placed that the maximum amount of surface is exposed for radiation. There is a space between the coils in each slot which allows a continuous draft of air to pass from the rotor through the slots to the outside. Thus a continuous circulation of air is effected through all the windings of the machine.

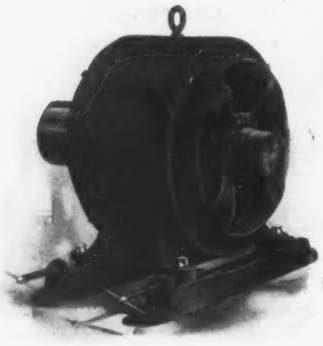


FIG. 1.—POLYPHASE INDUCTION MOTOR.

The primary core loss is kept low by using a specially good quality of iron worked at a low magnetic density. Thus the temperature is kept low and the efficiency high.

On account of the short air-gap required in induction motors, the bearings become the most important mechanical feature of the motor. In the induction motor here illustrated the bearings are made very large, and are well flooded with oil. The oil is carried up on the shaft by the usual ring oiling device. Distribution is effected by oil grooves which insure that all parts of the bearing will be equally well lubricated.

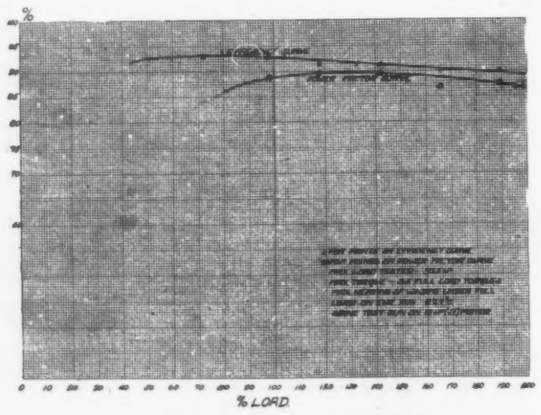


FIG. 2.—CHARACTERISTICS OF 15-HP MOTOR.

Fig. 2 shows efficiency and power factor curves of a 15-hp, 6-pole, polyphase, 1200-r. p. m., 60-cycle motor of this type. The efficiency of the machines is uniformly good, largely by reason of the low iron loss—a fact that is indicated by the accompanying efficiency curve which reaches maximum at about three-fourths of full load.

This line of induction motors has been placed on the market by the Lincoln Electric Company, 1232 East Third Street, Cleveland, Ohio.

Electrically-Driven Coffee Mills.

The coffee mills shown in the accompanying illustrations have been designed especially for use with electric motors.

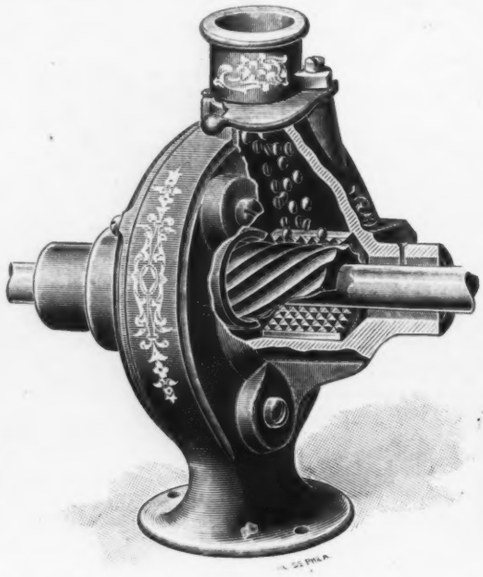


FIG. 1.—PART SECTIONAL VIEW OF MILL.

FIG. 2.—DOUBLE MOTOR-DRIVEN COFFEE MILL.

That is to say, the equipment as a whole has been arranged as a compact self-contained unit, each part being proportioned for its particular duty in connection with the other parts. The mills are provided with ball bearings to minimize the friction due to the thrust on the end of the grinder. The grinders themselves are arranged as pulverizers or granulators.

The motors are of either the direct-current or the alternating-current type, being designed for either 110 or 220 volts; a 500-volt direct-current motor can also be used. The switches and fuses are mounted on the base, the direct-current rheostat being placed inside the base. The alternating-current mill is driven by machine-cut gears working into a raw-hide pinion.

The mill is designed to break the coffee before it reaches the grinders. Fig. 1 shows grains of coffee dropping into the breaker, by which they are reduced to fragments and fed into the grinders. Fig. 2 shows a self-contained pulverizer and granulator mounted on a common base plate. These mills are built by the Coles Manufacturing Company, 1615 North Twenty-third Street, Philadelphia.

Reflectors for Picture Lighting.

For the proper illumination of pictures individually or collectively, the Frink system of reflectors made by I. P. Frink, of 551 Pearl Street, New York, has found extended use. For single picture lighting, an adjustable reflector the size of which is governed by the dimensions of the canvas is used. The reflectors are made on the proper angles so as to avoid glare and can be confined to small compass, making them unobstructive as they can be finished to match the surroundings. The Frink portable reflector can also be used to advantage in this connection. For concealed lighting of painted ceilings the Frink system is unsurpassed. The manufacturer has an extended experience in the illumination of paintings, etc., and the long list of public and private art galleries in which the Frink system of reflectors is installed attests to its excellence.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—On the whole, trade was quiet and industry slackened perceptibly, but the financial situation is easier. Mild weather is still complained of as affecting retail trade in seasonable goods. Job and wholesale trading were quiet. Quietness also prevails in industrial lines, a very general shut-down for the holidays being noted, and the textile trade, especially, has shown a tendency to further curtail output. Eighty per cent of the New England cotton spindles, it is stated, have agreed to reduce or curtail production in the next 60 or 90 days. The iron and steel trade is somewhat quieter, and the first cut in finished steel was made in steel bars to the extent of $2 per ton. There is some talk of export trade being sought in iron and steel and some large lots of sheet and tin plate bars are reported to have been disposed of for shipment to Wales. While business in pig iron continues quiet, the lower price levels have brought out some small orders. A buying movement is looked for after the holidays—in fact there is some talk now of purchases for investment. In finished iron and steel, trade hardly equals one-third of the output. Copper prices are firmer, the domestic demand for metal, however, being light; the advance is ascribed to speculation. The closing quotations are 13 7/16c. for Lake, 13 5/16c. for electrolytic, and 13 1/16c. for casting. *Bradstreet's* reports 248 business failures during the week ending Dec. 26, against 300 in the week previous and 161 in the corresponding week last year. Collections are still slow, but in many cities a currency basis has been established and the market for mercantile paper shows more activity. Railway earnings tend to diminish as the volume of business on the roads shrinks and the quantity of idle equipment increases. A very favorable feature in the situation is the increase in export trade in several lines, wheat being prominent in this respect. Another favorable feature is the announcement of resumption in many mills and factories, and the receipt by the Government Labor Bureau in Washington for 20,000 immigrants. Cotton exports are also of good volume.

AMERICAN EXPORT TRADE.—According to advices from Washington, the foreign commerce of the United States in 1907 makes a new record both as to imports and exports. While only 11 months' figures are yet available, the record for that period so far exceeds that of any corresponding period of earlier years as to justify the statement that the total of both imports and exports will be larger for the calendar year 1907 than in any preceding year in the history of our commerce. For the first time the monthly export record has crossed the 200,000,000 line, the total for November, 1907, being $204,444,860, while the import record of $133,110,170, made in March, is the largest total of importations in any single month in the history of our commerce. The figures at hand justify the estimate that the imports of the full year will exceed $1,400,000,000, and that the exports will probably exceed $1,900,000,000. If to this is added the trade with the non-contiguous territories of the United States, the value of the merchandise entering the ports of the continental United States would aggregate nearly $1,500,000,000, and the merchandise leaving the ports of the continental United States would aggregate nearly $2,000,000,000. The growth in the foreign commerce is chiefly in manufacturers' materials and manufactures. In imports, crude material for use in manufacturing shows for the 10 months for which figures are available an increase of about $40,000,000 over the corresponding period of last year, and manufactures for further use in manufacturing show an increase of about $29,000,000, while manufactures ready for consumption show an increase for the period named of $46,000,000. On the export side, raw materials for use in manufacturing show an increase of $48,000,000, manufactures for further use in manufacturing an increase of $13,000,000, and manufactures ready for consumption an increase of $29,000,000. In foodstuffs there is a slight increase in the importations, but a decrease in exportations, as measured by values. This increase in imports and exports occurs in the commerce with nearly all sections and countries of the world. To Europe the exports in the 10 months ending October were $1,003,000,000, against $970,500,000 during the coresponding months of last year; to North America, $308,000,000, against $269,333,330 during the 10 months of last year; to South America, $71,000,000, against $64,000,000 in the same months last year; to Asia and Oceanica, $116,500,000, against $105,000,000 in the corresponding months of 1906, and to Africa, $13,000,000, against $105,550,000 in the corresponding months of last year. The imports from Europe are $625,000,000 against $562,000,000 in the 10 months of 1906.

THE TELEGRAPH FIELD.—A recent dispatch from New Haven, Conn., stated that reductions in force would be made by the two big telegraph companies at the beginning of the new year. This is said to be untrue. This is the dull season with telegraph companies, and it was admitted that men were being laid off here and there temporarily, but no more extensively than in other years. From October to April business falls off and the companies adjust their working force to meet these conditions. In addition to denying the truth of published reports of retrenchment plans, Mr. Edward J. Nally, vice-president and general manager of the Postal, stated that the reports received at the main offices from the State superintendents and district managers were exceedingly optimistic for the future. As a further evidence of faith in the future Mr. Nally said that the company had not cut down the usual amount spent for betterments and improvements to the Postal system. He said that the company was looking for a good business after the holiday season, when it has always been at its lowest ebb. Even in the dull season, he said, the reports of managers in many places showed an increased business, and the expected recessions were not as marked as usual. No reductions in salaries of employees were being considered, he stated, and the only persons laid off were operators at points where business did not demand their services. This, however, was nothing unusual in the telegraph business, he said. At the office of Mr. Robert C. Clowry, president and general manager of the Western Union, it was stated that no general retrenchment plans were being or had been discussed. Business was slack, it was said, but nothing was thought of that at this season of the year. Employees were being released, it was said, to meet the requirements of business in some places, and being taken on in others. The Western Union force varied from day to day, but nothing being done, it was said, warranted any statement of retrenchment.

NEW YORK-PHILADELPHIA WIRELESS.—Preparations have been made for the establishing of a wireless telegraph system between Philadelphia and New York. Plans have been filed in the Philadelphia Bureau of Building Inspection, by a representative of the United States Wind Engine and Pump Company, of Batavia, Ill., for the erection of a 200-ft. wireless telegraph tower at Chestnut Hill, the companion of one that will be erected in the environs of New York. The tower will rest on concrete foundations and will be of steel and wood. It will be pyramidal in shape, the base measuring 30 ft. square and the altitude 200 ft. Besides the tower a building for the housing of the transmitting apparatus and for office purposes, will also be erected. Plans for this building have not yet been filed. Wireless messages will be received from New York at the Chestnut Hill station. Thence they will be conveyed by telephone to various parts of the city. To this end the operating company will establish stations in several sections.

COLORADO POWER SCHEMES.—It is announced from Denver that the Central Colorado Power Company, capital $22,500,000, and the Eastern Colorado Power Company, a subsidiary organization, capital $7,000,000, which practically ceased work on extensive canals and reservoirs connected with immense electric power schemes, when the Knickerbocker Trust Company failed, will resume operations with increased forces soon. The companies reduced their working forces by about 2000 men, although at no time was the underground work suspended. Interested in both companies are Thomas F. Walsh,

D. H. Moffat, and others of Denver, former Governor Myron Herrick, of Ohio, and Eastern, European and Colorado Springs millionaires. The companies will eventually supply all of eastern and central Colorado with electrical energy.

MEXICAN POWER PLANTS.—Advices from Mexico state that Rafael Bigot will establish a plant on the Las Balsas River, State of Michoacan, for his mines and reduction plant; Joseph E. Buell, at El Tajo, on the Ameca River, State of Jalisco; Manuel Pardo, on the San Diego River, State of Coahuila; Manual Marcias, on the Abra de Caballaros, State of San Luis Potosi; Victor Manuel Castillo, on the Chimalpa, State of Chiapas; Luis G. Saldivar, on the Lerma, State of Mexico; Jose M. Mena, on the Los Cadtillos, State of Guanajuato; Mrs. Leopoldo Gavito and sons, on the Atoyac, State of Puebla; Luis Pintado, on the Ameca, State of Jalisco; Thomas P. Honey and Jose L. Martinez, on the El Purgatorio, State of Puebla; Victor Manuel Castillo, on the Chimalpa, State of Chiapas; Charles B. Knocker, on the Moctezuma, State of Hidalgo; Eugenio H. Gayou, near Guaymas; Felipe Chavez, on the La Compania, State of Mexico; Luz Bringas, on the Blanco, State of Vera Cruz; Electric Power Transmission Company, of Hidalgo, on the La Santera, State of Hidalgo; Angel Diaz Rubin, on the Cantarranas, State of Puebla; S. P. Applewhite, on the Grande, State of Oaxaca; Rafael Garcia, on the Duero, State of Michoacan; Alberto Stein, on the Presidio, State of Sinaloa; Tri-States Development Company, on the Fuerte, State of Sinaloa; Macario Gonzalez Perez and Geronimo Martinez, on the Pupataro, State of Michoacan; Mrs. Elena V. Viuda de Ibarra, on the Tlapaneco, State of Puebla. Alberto Guarjardo, of Saltillo, is preparing to install an electric light and power plant at Villa Sabinas, State of Coahuila. Bernard McDonald, an American who has made a fortune in mines in Mexico, is at the head of a company to install a series of plants in northern Mexico, the Monterey Hydro-Electric Company, to expend about $3,000,000 on the Pilon River, near Montemorelos, State of Nuevo Leon. These plants will be three in number and more than 12,000 horse-power will be generated. The water will be brought from the river through a tunnel 8 miles long. The power will be transmitted to Monterey, Montemorelos and other towns of that region.

SALES OF STURTEVANT APPARATUS.—The popularity of the B. F. Sturtevant Company's generators is indicated through its electrical department. Mr. F. R. Chinnock, New York office, reports a few of the recent installations made by this company, are: Board of Water Supply, Babylon, L. I., one 9 in. x 8 in. vertical center crank engine, direct connected to one standard, slow-speed, 25-kw generator; Hanover National Bank, New York City, one 12 in. x 10 in. engine 50-kw generator; Eberhard Faber Pencil Company, Brooklyn, N. Y., one 16 x 14 horizontal automatic center crank engine, direct connected to a 100-kw generator; Bouker Contracting Company, New York City, one 4½ x 4½ engine, direct connected to a 5-kw generator; Central Union Gas Company, New York City, one 5 x 7 engine, direct connected to a 15-kw generator; Vulcan Detinning Company, Sewaren, N. J., one 7 x 7 vertical engine; Hotel Takanassee, Long Branch, N. J., one 16 x 14 engine, direct connected to a 75-kw generator, one 13 x 12 horizontal engine, direct connected to a 50-kw generator; H. J. McCoy, New York City, one 11 x 9 vertical engine; Washburn Brothers, Saugerties, N. Y., one 25-hp motor; New York State Reformatory for Women, Bedford, N. Y., one 13 x 12 horizontal engine direct connected to a 50-kw generator; Isidor Fajans, New York City, one 6 x 6 engine direct connected to a 10-kw generator; Votey Organ Company, Garwood, N. J., one 3½ x 3 engine, direct connected to a 3-kw generator; Johnson & Johnson, steamer *Robert Johnson*, one 10-kw generator, direct connected to a 6 x 6 vertical engine; Andrew McLean Company, Passaic, N. J., one 6 x 6 vertical engine; Royal Mfg. Company, Rahway, N. J., one 8 x 6 vertical engine, direct connected to a 6-kw generator; New York Engineering Company, New York City, three 4½ x 4½ vertical engines, directed connected to a 5-kw generator; Parker Engineering Company, New York City, one 14 x 14, direct connected to a 75-kw generator; Henry Steers, Inc., New York City, three 7½-kw generators; Samuel Smith & Sons, Paterson, N. J., one 14 x 14, direct connected to two 50-kw generators.

NAVY DEPARTMENT CONTRACTS.—Paymaster General E. B. Rogers, U. S. N., has recently issued the following circular letter, on behalf of the Navy Bureau of Supplies and Accounts: The bureau recently forwarded to certain manufacturers—160 in all—a circular letter explaining the recent improvements in the contract business of the Navy Department as regards (a) waiving of bonds and contracts on proposals less than $500 in value; (b) unloading, at Government expense, deliveries at navy yards; (c) obviating delays in payment for deliveries made, and (d) abolishing 10 per cent reservation from value of deliveries, etc., with a view of encouragaing competition, thus eliminating certain objectionable features of bidding. This letter has been given wide-spread attention through certain mediums—trade journals, jobbers' associations, etc.—and the impression has been created and disseminated broadcast throughout the country that the bureau intends to confine competition to manufacturers only, by refusing to consider bids from the wholesaler, jobber, retailer and middleman. The bureau has neither the desire nor the power to exclude any reputable dealer from bidding on naval supplies. All bids from such persons will be given the same consideration, and in each case award will be made to the lowest formal responsible bidder. By reason of the onerous requirements under the old form of contract many responsible firms were unwilling to deal directly with the bureau. By removing these onerous conditions it is hoped that such firms will bid directly for the Navy business, and, by thus widening competition, give to the Navy better prices and prompter deliveries.

UNION SWITCH AND SIGNAL.—Advices from Pittsburg state that on account of the large number of orders that are pouring into the company's office, the Union Switch & Signal Company, one of the large Westinghouse concerns, will not be allowed to remain idle for repairs as long as was expected. The plant closed down Dec. 20, expecting to remain idle until Jan. 8, in which time many needed repairs were to be made. Within the past week, however, the company has received an order for supplying the Pennsylvania Railroad tunnel in New York with switches and signals, the contract being for $2,000,000. The company has also received an extensive order from the Harriman lines. In consequence of these contracts, which will keep the big plant running day and night, the company sent notices to all of its employees to report for work Jan. 2.

HABIRSHAW WIRE COMPANY.—One of the interesting and important changes of the new year is that by which the India Rubber & Gutta Percha Insulating Company becomes the Habirshaw Wire Company. The product of this well-known concern has always been popular and familiar as "Habirshaw" wire and cable and Dr. W. M. Habirshaw has long been a dominating figure in this industry. Although not now giving such close attention to details as he once did, he keeps in touch with the growth of the art and is regarded as the leading authority on a subject that he has made so much his own as manufacturer, engineer and expert. The general feeling in the trade is that the change is a good one also in its advertising value, from such considerations.

CIRCUIT BREAKERS.—Mr. J. N. Kelman, of Los Angeles, Cal., has just completed, he states, "the installation of 75,000-volt circuit breakers in all the sub-stations on the Los Angeles Edison Company's 75-000-volt transmission line from Kern River to Los Angeles. These circuit breakers are operated by means of trip coils placed directly in the line, and to the best of my knowledge are the only circuit breakers for that voltage that are operated in this manner, if they are not the only 75,000-volt circuit breakers of any type in use on any system to-day. We have tested them thoroughly, and find that they are just as reliable as 500-volt direct-current breakers, such as are used on street railway work."

BUENOS AYRES SUBWAY.—U. S. Consul-General A. G. Snyder, of Buenos Ayres, Argentine Republic, reports that the city of Buenos Ayres has called for tenders for the construction of two lines of the underground electric railways which form part of the system proposed and approved by the Municipal Commission; and for the leasing of the operation of said lines upon their completion. The requirements of said bids can be obtained by interested parties from the office of the Secretary of Public Works of the Municipality, at Buenos Ayres. Bids will be received until May 1, 1908.

SPANISH TROLLEYS.—The Gaceta de Madrid states that the Spanish Director General of Public Works has granted a concession to La Compania General de Tranvias y Ferrocarriles Vincinales, of Alicante, Spain, to install electric traction on the tramways in Alicante, of which they are concessionaires.

BATTERY IN STEEL WORKS.—The Cambria Steel Company has just placed with the General Storage Battery Company an order for 45 G cells of Bijur battery, with automatic reversible booster and Bijur regulator, for use in their Franklin Works. This is a second order. The Cambria Steel Company uses two large ore bridges and one car dumper, all operated by electric motors and supplied with current by a set of feeders from the main power house, the center of the load being approximately 3000 ft. from the power house. The work of these motors is of necessity heavy and intermittent, so that the load on the power house fluctuates widely. The momentary current values vary from 400 to 4000 amperes, equivalent to rapid fluctuations in load from 100 to 1000 kilowatts at 250 volts. Prior to the installation of the storage battery, 12 cables of 500,000 circular mils were used as feeders (six outgoing and six returning), to supply the motors operating the ore bridges and car dumper. The voltage at the center of the motor load, at the same time, fluctuated through wide limits. It was found that the installation of a storage battery would maintain the voltage at the center of the load at a higher working value, would furnish a reserve in emergencies, and by dispensing with enough feeder copper to pay a good part of the cost of the battery. It was necessary, however, that the storage battery installed should go from charge to discharge, with small changes in voltage at its terminals; should be capable of being operated with little or no attention; should be able to withstand occasional overloads without detriment; and in emergency be able to stand fully discharged for short periods, without permanent injury. The battery installed is of the Bijur high-duty type, consisting of 106 cells having a capacity of 2400 amperes for 20 minutes. By the selection of the proper number of cells, the battery has been arranged so that while merely floating on the line, its total charge and total discharge over an extended period are equal, hence the state of charge of the battery remains substantially constant. In order to provide for an increase in the condition of charge, and to give occasional overcharges, required for best operation, a separately excited motor-driven booster is installed in the power station.

THE BRILLIANT ELECTRIC COMPANY FACTORY.—The new factory of the Brilliant Electric Company, situated at Conneaut, Ohio, has an annual output of 5,000,000 lamps. It is unusually advantageously located, being on both the Lake Shore & Michigan Southern Railroad and the New York, Chicago & St. Louis Railroad, and having easy access for lake shipments from the well-known Conneaut harbor. The building is three story, brick and iron construction, each floor having 13,330 sq. ft. The top floor, upon which most of the actual making of the lamp is done, is a light room without a partition or post to obstruct. It is the only factory which has been built especially and exclusively for the manufacture of incandescent lamps. The equipment is one of the most modern character and is entirely new throughout. Mr. H. F. Schadel, who has been in the lamp business for the past 25 years, is superintendent of the factory, under the management of Mr. E. J. Kulas, secretary and general manager of the company.

PLANING MILL PLANT.—A recent fire destroyed the building containing the planing mill and wood working shops of the Chicago, Milwaukee & St. Paul Railway, at West Milwaukee, making it necessary to rebuild and replace a portion of the equipment. The work of restoration is being rushed, and a contract has been let to Allis-Chalmers Company, of Milwaukee, for a 400-kw engine-type direct-current generator, 240 volts, 90 r. p. m. This machine is intended for lighting and motor service.

WIRELESS ON PACIFIC.—The steamship *Portland*, of the Alaska Coast Company, sailed from Valdez, Wash., for San Francisco, Cal., Dec. 26, equipped with wireless. The other boats of the Alaska Coast Company's fleet will be similarly equipped. The United Wireless Telegraph Company (De Forest system) is being used.

LARGE TESTING LABORATORIES.—There is now being installed in the plant of the Lima Insulator Company, at Lima, N. Y., a 450,000-volt testing apparatus, which will give to the company one of the largest testing outfits. The apparatus is being installed by the Central Laboratory Supply Company, of Lafayette, Ind.

THE AMERICAN THREAD COMPANY, Watuppa, Mass., recently purchased a duplicate of the 1500-kw Allis-Chalmers steam turbo-alternator ordered some months ago. The second unit was bought through the Thread Agency for the Kerr Mills, at Watuppa, and is a 60-cycle, three-phase, 550-volt machine.

Financial Intelligence.

THE WEEK IN WALL STREET.—During the early part of the week there was a depression in stock quotations, from which, however, there was a tendency later to recover sharply as the year closed. This improvement was due to renewed high rates for money on call and resultant liquidation and bearish pressure. An expectation of better financial conditions after Jan. 1 is supported by the weakness of foreign exchange and the renewed buying of commercial paper by interior and local institutions. The erratic action of the New York Central exerted some unfavorable influence, and the stock dropped to 89 on persistent selling and the absence of support. No explanation as to its behavior was given. Pennsylvania shares were sympathetically affected by this movement, and most of the standard railroad lines inclined to sell off more or less, similar irregular weakness being shown in the leaders of the industrial list, although the steel shares were relatively better supported than the others. Copper stocks were somewhat neglected in the transactions. The electric and traction stocks were as a whole weak and little business was transacted in them. Prices in most all cases slightly declined. The Curb market in a general way followed the movement of the stock market, with early weakness succeeded by an all-round rally. Following are the closing quotations of Dec. 31:

NEW YORK.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
Allis-Chalmers Co.	5⅞	6	General Electric 110		112
Allis-Chalmers Co. pfd..	16½	17	Hudson River Tel.....	—	—
Am. Dist. Tel.....	39	39*	Interborough Met. com.	6½	7⅛
American Locomotive..	37	34¾	Interborough Met. pfd..	17¼	18¼
Amer. Locomotive pfd..	88	36⅜	Mackays Cos.	51	54
American Tel. & Cable..	50	55	Mackays Cos. pfd.....	59⅛	60¾
American Tel. & Tel...101		100	Marconi Tel.	—	—
Brooklyn Rapid Transit.	38¾	39	Metropolitan St. Ry....	—	22
Electric Boat	—	—	N. Y. & N. J. Tel.....	94	92
Electric Boat pfd.....	—	—	Western Union Tel....	55	57
Electric Vehicle	—	—	Westinghouse com.....	43⅛	43
Electric Vehicle pfd...	—	—	Westinghouse pfd.....	60	—

BOSTON.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
American Tel. & Tel...101½		100	Mass. Elec. Ry. pfd....	—	38½
Cumberland Telephone.	—	—	Mexican Telephone.....	1¼	—
Edison Elec. Illum....	—	208	New England Telep....105		—
General Electric	—	112	Western Tel. & Tel....	—	—
Mass. Elec. Ry.....	—	8½	West. Tel. & Tel pfd...	—	—

PHILADELPHIA.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
American Railways.....	43	43	Phila. Electric	6¼	6⅛
Elec. Co. of America...	9¼	9½	Phila. Rapid Transit....	17	17¼
Elec. Storage Battery...	27	30	Phila. Traction	82½	—
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
Chicago City Ry.....150*		150*	National Carbon	—	—
Commonwealth-Edison ..	78	78½	National Carbon pfd....	—	—
Chicago Subway	15½	16½	Union Traction	—	—
Chicago Tel. Co.....105		105½	Union Traction pfd....	—	—
Metropolitan Elec. com.	16½	15*			

*Asked.

WESTERN UNION STOCK.—The $1,217,000 stock of the Western Union Telegraph Company which is to be listed on the New York Stock Exchange will be distributed to the stockholders as a quarterly dividend in conformity with the resolution adopted by the directors on Dec. 11. This issuance will make the total amount outstanding $98,587,000. This new stock will carry dividends accruing after Jan. 15. The authorized capital stock of the company is $125,000,000, of which $10,000,000 is reserved to take care of the outstanding $10,000,000 convertible 4 per cent bonds due 1936 and $15,000,000 will be reserved to take care of $15,000,000 of said bonds not yet issued. The stock to be listed is a part of the $13,800,000 increase authorized in 1892. It is expected that the company will right itself rapidly now the strike is a thing of the past. The company has a surplus on its books of $14,273,114.

NASSAU LIGHT MORTGAGE.—Stockholders of the Nassau Light & Power Company have voted to mortgage the property and franchise to secure $1,000,000 5 per cent bonds, dated Oct. 1, 1907, and payable Oct. 1, 1927. The plant is located at Roslyn, N. Y., and is operated under the management of J. G. White & Co. The system has grown very rapidly.

WESTINGHOUSE BONDS.—The receivers of the Westinghouse Electric & Manufacturing Company have given notice that interest on the bonds will be paid as usual, on Jan. 1, by the Farmers' National Bank, of Pittsburg. The earnings provide for the interest, with a very large margin.

WORCESTER ELECTRIC LIGHT.—The annual report of the Worcester (Mass.) Electric Light Company shows that the gross earnings for the year were $307,532, against $306,019 in 1906, a gain of $1,513. The receipts in 1905 were $294,459, showing a gain in 1907 from two years ago, of $13,073. The company declared an 8 per cent dividend for 1907, amounting to $51,096, leaving a surplus at the present time of $101,582. The statement in detail follows: Real estate, $94,647.42; steam plant, $98,805.27; electric plant, $118,324.47; electric lines, $704,-400.70; transformers, $28,972.51; meters, $20,663.17; arc lamps, $28,437; due for light and power, $30,362.86; fuel on hand, $4,590.10; carbons on hand, $2,270.17; oil and waste on hand, $22.56; incandescent lamps on hand, $11,148.52; globes on hand, $553.49; other materials on hand, $2,544.30; fixtures on hand, $1,529.95; horses, wagons, etc., $3,291.31; sundry accounts due company, $3,115.72; office furniture, $1,114.91; cash on hand, $258,835.26; total assets, $1,413,629.99. Liabilities—Capital stock, $754,800; unpaid bills, $42,938.05; deposits, $1,125; premium on new stock, $262,880; total liabilities, $1,061,743.05. Profit and loss balance, $351,836.94. Total, $1,413,629.99. Manufacturing account—Operating expenses at station, $62,155,08; cement bought, $1,538.75; distribution, $46,158.60; management, $17,285.18; taxes and incidentals, $27,683.10; total, $154,820.71; sale of light and power, $303,459.48; other sources, $4,040.02; total, $307,499.50. Profit and loss account—Balance last year, $323,454.18; balance of manufacturing account, $152,678.79; interest received, $5,438.33; jobbing, $199.39; other items of income, $23.32; total, $481,794.01. Dr.—Interest paid, $186.36; dividends declared, $51,096; depreciation, $78,624.71; balance, $351,886.94; total, $481,794.01.

DIVIDENDS.—The Consolidated Traction Company has declared a dividend of 2 per cent on its capital stock, payable on and after Jan. 15. Directors of the Washington, Alexandria & Mt. Vernon Railway Company have declared a dividend of 1 per cent, payable Jan. 2, 1908. Directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable Jan. 8. A dividend of 1 per cent has been declared on the capital stock of the Springfield Railway & Light Company, payable Jan. 2. A quarterly dividend of 1½ per cent has been declared on the preferred stock of the Evansville Light Company, payable Jan. 2. A quarterly dividend of 1½ per cent has been declared on the preferred stock of the Peoria Light Company, payable Jan. 2. The Electric Storage Battery Company has declared the regular quarterly dividend of 1¼ per cent on both the common and preferred stocks, payable Jan. 2. The United Traction and Electric Company of New Jersey has declared a dividend of 1¼ per cent on the capital stock. Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1¾ per cent, payable Jan. 15. The North American Telegraph Company's directors have declared the regular semi-annual dividend of 3 per cent, payable Jan. 1. The Coal & Iron National Bank of the City of New York has declared a regular quarterly dividend of 1½ per cent.

GENERAL ELECTRIC BUSINESS.—The General Electric Company continues to book a heavy volume of new business. New orders received during November aggregated about $4,200,-000, or at the rate of $50,000,000 gross for the year, and December sales will, according to present appearances, reach about the same figures. The fiscal year of the General Electric Company ends Jan. 31. Unless there is a totally unlooked-for shrinkage in business in January, it now seems probable that the current fiscal year will show gross sales even in excess of last year. In the year ended Jan. 31, 1907, the company booked orders for $60,483,659. For the nine months ended Oct. 30 last the new orders received totaled $49,677,500, so that if monthly orders for the last quarter averaged no higher than the November total, gross sales for the year would run in excess of $61,600,000, or more than $1,000,000 greater than in the 1907 year. The officials of the company are shaping their plans to handle a gross business during the coming fiscal year of not less than $50,000,000.

DETROIT TROLLEY EARNINGS.—The Detroit United Railway will close the year 1907 with an increase of about $700,000 in its gross earnings over the year 1906. The gross earnings up to Dec. 1 were $6,166,479, which is an increase of $616,392 over the same period last year. The average increase a month for the 11 months was about $56,036, which amount for December added to the $616,392 would bring the total to $672,-428. Operating expenses and taxes were $3,836,748, an increase of $440,755 over the 11 months of 1906. This leaves net earnings of $2,329,731 for 11 months of 1907, an increase of $175,637 over 1906. Other income in 1907 amounted to $49,117, an increase of $8,222, making the total income $2,378,848, an increase of $183,859. The charges in 1907 were $1,263,830, an increase of $127,534, leaving a surplus of $1,115,018 for the 11 months, an increase of $56,325.

BOSTON WEST END.—The Massachusetts Railroad Commission has approved of an issue of 20,218 shares of additional common stock by the West End Street Railway Company, and fixed the issue price at $70 per share, plus the amount of dividends which shall have accrued on said stock under the provisions of the lease to the Boston Elevated at date of payment for the same. This is the amount of stock asked for as reasonably necessary for payment to the Boston Elevated for additions, improvements and alterations made from April 1, 1904, to Sept. 30, 1907, to the amount of $2,135,750. The stockholders have voted in favor of the issue. At the present time the West End owes the Boston Elevated $2,139,000. The new stock will provide $1,415,000, leaving a balance of $724,000 to be taken care of by the issuance when conditions warrant of $750,000 5 per cent 15-year bonds.

CHICAGO CONSOLIDATION.—The South Chicago City Railway Company and the Calumet Electric Street Railway Company are to consolidate. An agreement between the officials of the two corporations has been reached, but the papers have not been signed. The Calumet Electric is still in the hands of a receiver, but of recent years has been doing a fairly good business. Ira M. Cobe, the receiver, confirms the news of the consolidation. According to Mr. Cobe, the Calumet Electric has issued bonds in the amount of $3,000,000, which fall due Nov. 1, 1909. There are $500,000 in stock and $675,000 of receivers' certificates outstanding. The South Chicago City Railway Company operates 37 miles of track within the Chicago city limits and the Calumet Electric operates 75 miles.

NEW ENGLAND TELEPHONE.—The New England Telephone & Telegraph Company will close its current fiscal year with the best record of gross and net earnings in its history. Gross earnings will run in excess of $10,500,000, while the gain in net will be considerably in excess of the customary annual increase of $200,000. The New England Telephone Company during the past 12 months has been able to cut down its operating ratio by practical business economies without in any way curtailing maintenance or impairing efficiency of service. The construction work installed during 1907 has been confined largely to actual necessities, so that construction account will show a substantial cash credit at the end of the year.

MEXICAN LIGHT & POWER.—The Mexican Light & Power Company has sold an additional $2,400,000 of its 7 per cent preferred stock in London. The entire amount was underwritten by Sperling & Company, of that city. The new issue makes the total share capital outstanding $15,400,000, United States currency. The proceeds of the new issue will be used to complete the construction of the company's works at Necaxa.

AUTOMATIC ELECTRIC.—According to advices from Chicago, a director says that the mortgage for $1,000,000 in 6 per cent bonds to be placed ahead of the stock should not interfere with dividends. The obligation thus created, amounting to $60,000 a year, is about one-half the amount the Automatic has paid the Strowger Telephone Company in royalties.

WESTERN ELECTRIC STOCK.—Nearly half of the 700 minority stockholders of the Western Electric Company have assented to the American Telephone & Telegraph Company's offer to take over their holdings for bonds or cash, but not one-half of the $6,000,000 minority holdings. A large majority of the stock is expected before Jan. 20, the time limit.

MEXICAN TELEGRAPH.—The Mexican Telegraph Company for the three months ended Dec. 31, shows a gross of $185,000, expenses of $35,500, a surplus after dividend, etc., of $97,248, and a total surplus of $2,156,340. The Central & South American Telegraph Company had a gross of $425,000, expenses of $145,000, a surplus after dividends, etc., of $139,948, and a total surplus of $1,146,447.

HUDSON RIVER POWER.—The Hudson River Electric Power Company reports earnings for November as follows:

	1907.	1906.	
November gross	$124,860	$85,763	Inc. 10,853
Expenses	60,804	49,763	Inc. $39,097
November net	$64,056	$35,812	Inc. $28,244

GENERAL NEWS

Construction News.

BREWTON, ALA.—The citizens are contemplating installing two new boilers of 150-hp. each, in the municipal electric light plant and water works, and erecting a 100,000-gallon stand-pipe. G. E. McCants is manager.

EDMONTON, ALB.—R. R. Kelly, city engineer, writes that bids will probably be called for at once for the construction of a power station building and six miles of transmission lines. The cost of the proposed work is estimated at $40,000.

HEADLAND, ALA.—J. L. Kelly, mayor, writes that the citizens on Dec. 16 voted to issue $23,500 in bonds for the construction of water works and an electric light plant.

GLOBE, ARIZ.—The local electric light and gas plants owned by Messrs. Cotter and James, have been sold to A. F. Gressler, of Bisbee, and W. D. West of Chicago, Ill. The new owners contemplate making improvements and increasing the equipment of both the electric and gas plants.

PHOENIX, ARIZ.—Redmond Toohey and Harry J. Bennett have applied to the Board of Supervisors of Maricopa County for a franchise to construct and operate an electric railway between Phoenix and Mesa by the way of Tempe.

LITTLE ROCK, ARK.—The Walnut Hill Telephone Company has filed a certificate with the Secretary of State changing the location of its business to Bradley, and providing for the construction and operation of local lines in Walnut Hill, Lewisville and Waldo.

VAN BUREN, ARK.—The Fort Smith Light & Traction Company, of Fort Smith, has been granted a franchise for a term of 50 years to distribute electricity for light, heat and power purposes in Van Buren.

BISHOP, CAL.—W. H. Snyder, of Snyder's Camp, near old Chrysoplis, states that mines there are to be opened on a large scale, and that the owners contemplate an expenditure of from $500,000 to $1,500,000 in developing the mines. It is said one of the earliest steps will be the erection of an electric plant on Big Pine Creek to transmit electricity to the camp for use in milling.

COMPTON, CAL.—The Compton Electric Light & Power Company contemplates extending its lines to Watts and Willow Brook. G. R. Fulton is secretary and manager.

ESCONIDO, CAL.—A. Steiner and W. A. Sickler are interested in a project to erect an electric light and power plant to be owned and operated by the people in connection with a water system, which they have developed.

FILLMORE, CAL.—The Pacific Coast Telephone Construction Company has submitted a proposition to the directors of the Board of Trade, proposing to construct a local telephone system, provided 100 subscribers can be secured.

FRESNO, CAL.—The Kings River Power Company, of Los Angeles, has given notice of the appropriation of 25,000 miner's inches of the water from the Kings River to operate machinery for the generation of electrical energy to be transmitted to Fresno, San Francisco and Los Angeles.

HAYWARD, CAL.—The Pacific States Telephone & Telegraph Company is planning to erect a building here for its exchange, to cost about $10,000. The company will also install a two-party line system throughout the town. F. C. Michel is resident manager.

HERMOSA BEACH, CAL.—The City Council is considering the question of installing a municipal electric light plant.

JUNCTION CITY, CAL.—The Northern California Power Company has been granted a permit to occupy a right of way 27 miles long for a transmission line through the Trinity National Forest Reserve.

MARE ISLAND, CAL.—We are informed that plans are being made to place the electric wires underground in the center of the yard at the Mare Island Navy Yard. A 250-kw motor generator has just been installed to furnish direct current for motors. Electricity for the navy yard plant is furnished by the Bay Counties Power Company.

MONROVIA, CAL.—The City Council has awarded the contract for the installation of a new plant at the city wells to the Edison Electric Company, of Los Angeles, for $11,450.

MORENO, CAL.—Steps have been taken by the Los Angeles & San Diego Beach Railway Company for condemnation proceedings to secure a tract of land on which to erect its power station in this place. As soon as the property is secured work will commence on the construction of the plant. The plant will furnish electricity to operate the La Jolla line.

OAKLAND, CAL.—The Oakland Traction Company is planning extensive improvements and additions to its system during the coming year, including the building of ten miles of new track, the erection of a new power station having a rating of 10,000 kilowatts and sub-stations. Twenty interurban cars and ten standard railway coaches will be built at the shops of the company.

OCEAN PARK, CAL.—The Seaboard Construction Company has presented to the Board of Trustees of Ocean Park a plan for providing a gas and an electric lighting plant, which will receive the attention of the board at its regular meeting.

PASADENA, CAL.—The City Council has decided to call a special election to vote on the proposition to issue $50,000 in bonds, instead of $200,000, for the completion of the electric light plant. The election will probably be held the latter part of this month or the first of February.

SAN FRANCISCO, CAL.—The Board of Supervisors has granted the Merchants' Ice & Cold Storage Company permission to erect and maintain an overhead electric cable for the purpose of transmitting electricity for operating a pump on the wharf to convey salt water to the property of the company located at the corner of Sansome and Lombard streets.

SAN RAFAEL, CAL.—The Snow Mountain Power Company will soon begin to erect poles for its transmission line in Marin County. The company is now erecting a large sub-station at Vichy Springs.

SANTA ANA, CAL.—The Anaheim Chamber of Commerce is considering the advisability of installing electric lamps along the road from Santa Ana to Fullerton.

SANTA MONICA, CAL.—The Santa Monica Bay Home Telephone Company has increased its capital stock from $250,000 to $500,000. The company is contemplating making extensions to its system and entering new territory.

SANTA ROSA, CAL.—The Santa Rosa Lighting Company contemplates changing its system from two to three phase and rewiring the town. R. Leo Van de Naillen is manager.

COLORADO SPRINGS, COL.—It is reported that work will soon commence on the construction of the proposed electric railway of the Manitou & Crystal Park Railway Company, from Manitou to Crystal Park. The cost of the road is estimated at $500,000. J. K. Vannatta is president of the company.

HOTCHKISS, COL.—J. W. Lee, representing the Colorado Fruit Company and the Hotchkiss Packing & Power Company has been granted a franchise to operate an electric light plant for a term of 20 years. The company was organized for the purpose of furnishing the town with electricity for lighting and also for running a canning factory and evaporator.

JEWETT CITY, CONN.—Extensive improvements are being made to the borough municipal electric light plant. A new generator was recently installed and other changes are being made.

HARRINGTON, DEL.—The Coursey mill property has been purchased by the local heat, light and power company, which proposes to erect an electric light plant on the site.

WASHINGTON, D. C.—Bids will be received at the office of Bernard R. Green, superintendent of construction of the National Museum of Congress, until Jan. 21, for furnishing and installing complete the electric wiring required for the new building for the National Museum.

ST. PETERSBURG, FLA.—Charles Braaf is considering plans for irrigating his property in Northern Mobile, in connection with an artesian well recently sunk, which will furnish water to irrigate the land and power to operate an electric light plant.

ATLANTA, GA.—The Atlanta Telephone Company has petitioned the City Council for the right to place additional underground conduits on Edgewood Avenue.

TYBEE, P. O., SAVANNAH, GA.—Messrs. Stubbs & Keen are contemplating the installation of an electric light plant in connection with a summer resort, and are in the market for prices for electrical machinery.

GRANGEVILLE, IDAHO.—The Grangeville Electric Light & Power Company is planning to double the present output of its plant and extend its transmission lines to Cottonwood, twenty miles distant. D. C. Van Buren is manager.

MORAVIA, IDAHO.—Plans are being considered for organizing an electric light and power company in this place. Nels Peterson, H. Rolling and others are interested in the project.

RATHDRUM, IDAHO.—The A. O. Skinner Electric Light & Power Company is contemplating erecting five miles of high-tension transmission line. H. R. Saunders is secretary and manager.

REXBURG, IDAHO.—The Falls Power, Light & Water Company has decided to extend its high-tension transmission line from Blackfoot to Rexburg.

FLANAGAN, ILL.—It is reported that the Village Board is considering the proposition of installing an electric light plant.

JOLIET, ILL.—The Economy Light & Power Company is constructing an 8000-hp hydro-electric plant. Charles A. Munroe is manager.

EVANSVILLE, IND.—C. M. Katterjohn, superintendent of the Cumberland Telephone Company, has asked the Council for an extension of time from Jan. 1 to May 1 for installing new equipment and making other changes in the telephone system provided for in the franchise secured several months ago. It is the intention of the company to install a

central energy system with the latest improved equipment. A new switchboard and other new fixtures will be necessary and changes are being made in the wires and cables.

HAGERSTOWN, IND.—The contract for the construction of the new municipal electric light plant has been awarded to Wesley Cornel, of Cambridge City.

INDIANAPOLIS, IND.—The Trustees of the Central Indiana Hospital for the Insane are asking for proposals for the installation of a direct-current generator, direct connected to a steam unit (engine or turbine) foundations, steam connections, switchboard panel and all necessary connections. Bids will be received until Feb. 4.

KNIGHTSTOWN, IND.—The question of issuing bonds to secure funds with which to reconstruct the municipal electric light plant was submitted to a vote of the taxpayers on Dec. 27, resulting in favor of the improvement.

DES MOINES, IA.—The controlling interest in the Hawkeye Telephone Company, the branches of the mutual telephone organization, in Dallas, Guthrie and Polk counties, has been sold by President G. N. Brady to the Brenton Brothers, of Dallas Center. Charles R. Brenton will become president of the company upon the retirement of Mr. Brady, and D. R. Griswold will be the secretary and general manager.

KEOKUK, IOWA.—Preliminary surveys have been completed for the Keokuk & Columbus Railway Company, which proposes to construct an electric railway to connect Keokuk, Charleston, Columbus Junction and intervening cities. The road will be about seventy-five miles in length and will be operated by electricity. J. E. Peterson, of New London, is president, and T. A. Craig, of Keokuk, secretary.

VENTURA, IA.—The Western Electric Telephone Company is planning to consolidate the different telephone lines running into Ventura and using the same central office.

WEBSTER CITY, IA.—The managers of the municipal electric light plant are changing the plant from 110 to 220 volt, three-wire system. R. J. Mullins is manager.

HERINGTON, KAN.—The water and light committee is contemplating the rebuilding of the electric lighting plant soon. C. E. Stromquist is general manager.

HUMBOLDT, KAN.—The managers of the municipal electric light plant are contemplating establishing a day service next spring. W. A. Moore is superintendent.

RICHMOND, KY.—We are informed that the Richmond Electric Power Company will install an additional boiler in its plant next summer. The General Engineering Company, of Cleveland, Ohio, has charge of the plant.

MIDWAY, KY.—The Versailles Electric Light Company is making arrangements to extend its transmission line to Midway, a distance of six miles. The company has a franchise in Midway. Harry Reid is president and manager.

CROWLEY, LA.—Armas Durio, superintendent of the municipal electric light and water works plant, writes that an additional boiler will be installed in the plant next summer.

BRUNSWICK, ME.—The Brunswick Electric Light & Power Company has filed a notice with the Secretary of State showing an increase in the capital stock of the company from $50,000 to $100,000.

LEWISTON, ME.—The Lewiston & Auburn Electric Light Company has announced a reduction in the price of electricity for lamps in Lewiston and Auburn from 9 cents per kw-hour to 8 cents per kw-hour, beginning with Jan. 1. A short time ago the company reduced its rate from 10 cents to 9 cents per kw-hour.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has awarded the contract for improvements to its Penn Street electric sub-station. A new roof, etc., will be built and a cable and wire tower will be constructed. P. O. Keilholtz is engineer.

AMESBURY, MASS.—The State Board of Gas and Electric Light Commissioners has authorized the Amesbury Electric Light Company to issue bonds to the amount of $50,000.

CLINTON, MASS.—The Clinton Wire Cloth Company proposes to install a new 500-hp dynamo to generate electrical energy for use in its plant. At present the Clinton Electric Lighting Company is furnishing electricity for the plant.

COTTAGE CITY, MASS.—Extensive improvements are being made to the plant of the Cottage City Gas & Electric Light Company. Some of the old equipment is being removed and replaced by new.

GLOUCESTER, MASS.—The Board of Aldermen has approved the contract submitted by the committee on fuel and street lights with the Gloucester Electric Company for street lighting for a term of five years. The company is to furnish not less than 90 arc lamps at $80 each per year and 650 tungsten incandescent lamps at $14.50 per lamp per year. Under the new contract the committee has secured a reduction in the price of arc lamps from $82 to $80 per year, and the incandescent lamps of 25 cents per lamp, making a saving of $128 per year on arc lamps and $131 on incandescent lamps per year.

HYDE PARK, MASS.—Plans are being drawn for an electric power plant for the Becker Brainard Milling Machine Company in Hyde Park, the cost of which is estimated at $60,000.

MALDEN, MASS.—The Malden Electric Company has petitioned the State Board of Gas and Electric Light Commissioners for an approval of an issue of $150,000 additional capital stock to retire the floating debt incurred in enlargements to its plant.

ROYALSTON, MASS.—A representative of the Connecticut Power & Light Company, of Boston, Mass., has been in town recently looking up the route and getting permission to set poles for a transmission line from Vernon, Vt., to Boston. The company is building a large power plant in Vernon for the purpose of transmitting electricity to Boston and proposes to furnish electricity for lamps and motors to towns on the route.

STOCKBRIDGE, MASS.—The State Board of Gas and Electric Light Commissioners has granted the petition of the Stockbridge Lighting Company to issue its initial capital to the amount of $25,000, par value.

WINTHROP, MASS.—The citizens on Dec. 10 voted to enter into a contract with the Suburban Gas & Electric Company, of Revere, to light the town for a term of five years. Under the new contract the streets are to be lighted all night. At present the lamps are extinguished at 1:30 o'clock in the morning and relighted at 4:30.

CADILLAC, MICH.—Work on the Tyler dam of the Electric Land & Development Company has been suspended, but officials of the company state that it will be resumed after the holidays. The money stringency is assigned as the cause of the delay.

GLADWIN, MICH.—Schulz & Prindle, owners of the local electric light plant, are contemplating establishing a day service. F. L. Prindle is manager.

MARQUETTE, MICH.—The total income of the municipal electric light plant for the sale of electricity during November was $7,819, and the expenditures only $3,641, leaving a balance of $4,178. The rates for lighting are five cents per kilowatt-hour for business places and seven cents for residences. It is stated that a new and larger plant will be erected within the next year or two, and it will be built largely from the earnings of the present plant, without the aid of a bond issue.

OWOSSO, MICH.—The Shiawassee Light & Power Company has applied to the city for a 20-year franchise and a lighting contract for a term of 10 years.

PETOSKEY, MICH.—W. L. McManus, who was refused permission to run wires from his sawmill to the Cushman House, which he recently purchased, now wants to purchase the municipal lighting plant, which has been operated by the city for fifteen years. He has asked the Council to set a price. The plant under municipal control has piled up a big deficit.

ALEXANDER, MINN.—The village is contemplating the construction of a new station to replace the present municipal lighting plant. C. A. Johnson is manager.

BRAINARD, MINN.—The City Council has authorized an issue of $25,000 in bonds to aid the Mississippi Water Power & Boom Company in constructing a dam in this city.

BRECKENRIDGE, MINN.—The Breckenridge Telephone Company has been formed and is making plans for the installation of a local exchange.

CROOKSTON, MINN.—The Crookston Water Power & Light Company is contemplating the construction of a large power plant on Red Lake, a distance of 12 miles from the city. Nothing will be done for the present, owing to the stringency in the money market.

NEW PRAGUE, MINN.—The citizens contemplate putting in a storage battery in the municipal electric light plant next spring. A. K. Adams is superintendent.

NORTFIELD, MINN.—The Northfield Light, Heat & Power Company has obtained a lease on a mill property at Waterford, two miles distant, and will develop a water power of from 150 to 210 horse power. The company will install a 120-kw Westinghouse, alternating-current generator, and will also furnish a day service. The present plant of the company will be connected with the water-power plant about Feb. 1. A. K. Ware is president.

PRINCETON, MINN.—The village is contemplating installing an air lift pump, fire pump and induced draft system in the electric light and water works system. C. A. Dow is superintendent.

ST. PAUL, MINN.—The City Assembly on Dec. 23 accepted the bid of the St. Paul Gas Light Company to furnish both gas and electric lighting.

ST. PAUL, MINN.—The West Side Power, Heating & Lighting Company has filed amended articles of incorporation with the Secretary of State increasing its capital stock from $50,000 to $300,000.

NATCHEZ, MISS.—Plans and specifications for a municipal electric lighting plant are now being prepared by Krumbbaar & Aiken, of New Orleans, La. The plans call for a series, alternating-current, arc-lighting system of 150 lamps.

YAZOO CITY, MISS.—The city has awarded contracts for the construction of about three miles of new track, and also proposes to repair the car house and install a generator and engine in the power house. The city will purchase four additional cars in the near future. James S. Butler is superintendent of the street railway system.

BROOKFIELD, MO.—The Brookfield Electric Light Company is contemplating the installation of a three-phase power service and will establish a 24-hour service in the spring. Percy W. Markham is superintendent.

HARLOWTON, MONT.—A. C. Graves, of this place, contemplates the

construction of an electric light plant and water works system here, to cost about $20,000. Bids for construction of the plant will probably be called for in March. The engineer has not yet been selected.

TOWNSEND, MONT.—The managers of the municipal electric light plant are contemplating installing a new alternator and arc circuit for street lighting; also meters. G. F. Ramspeck is manager.

CHADRON, NEB.—The Chadron Electric Light & Power Company is installing an Erie Ball engine direct connected to a 75-kw Crocker-Wheeler two-phase generator to replace a Buckeye high-speed engine. W. J. McCarthy is manager.

MALMO, NEB.—The Village Trustees have appointed a committee to investigate the cost, etc., of installing water works and an electric light plant.

PERU, NEB.—The Peru Electric Light & Power Company is contemplating extending its transmission line into the country and also establishing an alternating-current day service. L. K. Pettit is superintendent.

SUPERIOR, NEB.—The Superior Electric Light Company is contemplating establishing a day circuit. Walter M. Lee is manager.

TEKAMAH, NEB.—The managers of the municipal electric light plant are contemplating erecting about 30 blocks of pole line next spring. W. F. Poot is superintendent.

SPARKS, NEV.—Engineer E. Talbot, of Carson City, writes that the proposed power plant to be constructed on the Truckee River, 18 miles east of Reno, will cost about $250,000. The matter has been held up by litigation until July, 1908. Nothing definite will be done until after that time.

CLAREMONT, N. H.—L. N. Wheeler, manager of the Claremont Power Company, writes that the company is completing the installation of a 500-hp Diesel oil engine direct connected to a 300-kw, 2300-volt, 60-cycle, three-phase generator at its plant in Claremont, and has also nearly completed the construction of a hydro-electric plant at Cavendish, Vt., on Black River, where the company is installing three 750-hp Pelton water turbines under 120-ft. head direct connected to three 500-kw, 11,000-volt, 60-cycle, three-phase generators. The transmission line from Cavendish to Claremont, a distance of fifteen miles, is nearly completed.

CONTOOCOOK, N. H.—A new electric light plant has been installed in connection with the new mills at West Hopkinton.

WARREN, N. H.—The Warren Water & Light Company contemplates extending its transmission lines to Rumney for the purpose of furnishing electricity for lighting at Rumney, Wentworth and West Rumney. The company also contemplates utilizing the water power at Baker Pond, in Orford.

JERSEY CITY, N. J.—The Jersey City Electric Company has secured the contract for electric wiring of School No. 9, for $1,650.

DEMING, N. M.—The Deming Ice & Electric Company is rebuilding its plant and will extend its local service. C. M. McCamey is treasurer and manager.

BATH, N. Y.—The Village Trustees last summer refused the application of the Bath Electric Light Company for a new contract, alleging poor service. The franchise was then granted to Clinton Tower, of Buffalo, who agreed to have a new plant for street lighting in operation by Oct. 1. Mr. Tower failed to have the plant ready and asked for an extension of time, which the Trustees granted. At a meeting of the Trustees held recently Mr. Tower asked the Trustees to annul the franchise given him and to grant him an entire new franchise. The reason given for this request is that he has allowed the first franchise to become possessed by several New York City capitalists, who will not surrender the franchise unless they are paid $1,500. The Bath Electric Light Company, at the request of the Village Trustees, is still supplying the street lighting service at the schedule of prices as stipulated in the old franchise.

OSWEGO, N. Y.—The People's Gas & Electric Company is contemplating installing a 500-kw steam unit in its plant. J. M. Dickenson is manager.

SODUS, N. Y.—The Public Service Commission has granted the Sodus Gas & Electric Light Company permission to extend its transmission lines from Sodus to Webster and to Sodus Point, and to increase its capital stock from $15,000 to $90,000 for this work.

HENDERSONVILLE, N. C.—The Hendersonville Light & Power Company will develop water power not far distant from its present plant, which will practically double the output of the present plant. Orders have been placed with the S. Morgan Smith Company, of York, Pa., for water wheels. W. H. Bangs is superintendent.

LITTLETON, N. C.—It is reported that A. E. Gonzales and W. H. Lyles, of Columbia, S. C., have acquired water power rights on the Broad River at Littleton, and contemplate building a dam for developing power.

COOPERSTOWN, N. D.—The Platt Electric Company is making extensive additions and improvements to its plant. The location of the plant has been changed and a new 125 horse-power Weber gas engine, and also another generator having a rating of 70 kilowatts, are being installed in the plant. Frank J. Simpson is treasurer and manager.

ENDERLIN, N. D.—The Enderlin Electric Light & Power Company contemplates installing a gas producer and extending its lines to Sheldon. M. A. Abbott is manager.

LEWISBURG, OHIO.—The citizens on Dec. 24 voted to issue $26,000 in bonds for the construction of a combined electric light plant and water-works system.

MILLERSBURG, OHIO.—Announcement has been made that the Millersburg & Eastern Railroad Company will soon commence work on the construction of its road, which will connect Millersburg, Willmot, Berlin Trail and Beach City. The road will be about twenty-six miles long and will be operated by electricity. D. S. Olmstead, of Millersburg, is president.

RAVENNA, OHIO.—The Ravenna Gas & Electric Light Company is now changing over its plant from the single to the three-phase system. E. C. Lindsey is superintendent.

BARTLESVILLE, OKLA.—The Bartlesville Electric Light & Power Company is contemplating installing a 300-hp. water-tube boiler and erecting several miles of transmission line. S. J. Smallwood is president and general manager.

PANAMA.—Bids will be received until Jan. 20 by Lieut.-Col. H. F. Hodges, U. S. A., Washington, D. C., for an engine and generator, engine-driven exciter, storage battery, incandescent globes, hydrometers, sand pump, pump governors, steel tubing, etc., as per circular No. 412.

BRADFORD, PA.—The Bradford Electric Light & Power Company is contemplating the installation of new arc lamps. J. H. Rose is manager.

DANVILLE, PA.—Plans are being made by the Standard Electric Light Company to change its system from 133 to 60 cycles. George M. West is superintendent.

LANCASTER, PA.—The Lancaster County Railway & Light Company has recently installed a 1500-hp engine in its power house at Engleside.

OLYPHANT, PA.—The borough electric light committee contemplates establishing a day service and will install a new engine, generator and boilers in the municipal electric plant. W. J. Lynott is chief engineer.

PITTSBURG, PA.—The Ardmore Street Railway Company has filed with the State Department a notice of an increase in its indebtedness of $1,250,000 for improvements.

QUAKERTOWN, PA.—Plans are being made to change the system of the municipal electric light plant to two phase, 60 cycles. The present system is single phase, 125 cycles. G. Frey is superintendent.

ANDERSON, S. C.—The Anderson Traction Company is contemplating extending its lines from Belton to Greenville, which means the construction of twenty-five miles of new track.

FLORENCE, S. C.—The City Council is considering the question of more and better street lamps for lighting the streets of the city, and also the question of municipal ownership of the lighting plant. The contract between the city and the Florence Light & Power Company will expire early in 1908. The service given by the company is not all satisfactory and some other arrangement for lighting the city will have to be made.

NEWBERRY, S. C.—Plans are being considered for enlarging and improving the electric light plant and water-works system, which will include the installation of a new 200-kw generator and a well pump. H. W. Schumpert is superintendent.

SUMMERVILLE, S. C.—The Crystal Ice Company is planning to install a 125-kw generator and a 175-hp engine and boiler in its plant next fall. Milton P. Skinner is president and treasurer.

FULTON, S. D.—Lincoln Eves, of Meckling, has purchased the Fulton telephone exchange, and will install a new switchboard and make other improvements.

HARTFORD, S. D.—The Hartford Electric Light & Telephone Company contemplates the installation of a storage battery in its plant. Fred B. Harris is manager.

VEBLEN, S. D.—We have been informed that the Veblen Traction Company, which was recently incorporated, with a capital stock of $500,000, to build an electric railway between Lidgerwood and Veblen, will begin construction work next spring. The railway will be thirty miles long and the overhead trolley system will be used. The officers are: B. P. Hammersbach, of Veblen, president; E. A. Movius, of Lidgerwood, vice-president; J. B. Holsey, of Veblen, secretary, and George F. Anderson, of Veblen, treasurer.

JEFFERSON CITY, TENN.—The Jefferson City Electric Company contemplates installing a compound engine and a three-phase, direct-current generator to furnish power for a large woolen mill, and also installing arc lamps for street lighting. I. M. Coile is secretary and manager.

BEAUMONT, TEX.—The Beaumont Ice, Light & Refrigerating Company is planning to change its primary voltage from 1100 to 2200 volts. Joseph E. Carroll is president and manager.

COLUMBUS, TEX.—The Columbus Light Company contemplates the installation of a new boiler in its plant. J. Shaw is secretary and manager.

GONZALES, TEX.—The Citizens Electric Light & Power Company is planning to install two new generators in its plant in the spring to furnish electrical energy to operate an oil mill and cotton mill. T. H. Spooner is secretary and manager.

LODI, TEX.—George Gordon, village president, writes that the village recently purchased the local electric light plant and is now reconstructing the same at a cost estimated at about $10,000.

MERKLE, TEX.—The Merkle Light & Power Company will install a fifteen-ton ice plant in connection with its electric light plant. J. C. Hamm is president and manager.

QUANAH, TEX.—The Quanah Light & Ice Works has remodeled its plant and increased the output and changed the system from 133 to 60 cycles. E. A. Clausnitzer is owner and manager.

BRATTLEBORO, VT.—The Connecticut River Power Company is constructing a hydro-electric plant for long-distance transmission. J. G. White & Company, of New York, are designing the plant and equipment, plans for which have not yet been decided upon. H. S. Harriman is general manager.

FORT COVINGTON, VT.—The Fort Covington Light, Heat & Power Company is considering the question of building a new dam and establishing a day service next summer. W. S. H. Keefe is manager.

ROANOKE, VA.—The Roanoke Water Power Company contemplates the installation of a 1000-kw Allis Chalmers generator as an auxiliary to its present plant. R. C. Camp is general manager.

NORTH BEND, WASH.—Henry Hewitt, of Tacoma, has obtained franchises from the cities of Marshfield and North Bend, to construct and operate an electric light plant and street railway system in both cities.

POMEROY, WASH.—The Tucannon Power Company is making arrangements to install a steam plant to provide against freshets or accidents which may put its water power plant out of commission. The company is now installing a 158-hp Lane & Bodley Corliss engine in its plant, and has placed an order for a 100-kw generator. The work is being done under the supervision of J. J. Henley and W. W. Richardson.

CHARLESTOWN, W. VA.—The Kanawha Water & Light Company is contemplating installing 50 additional 6.6 amp. arc lamps on its street lighting system. G. F. Maddock is manager.

GRAFTON, W. VA.—John T. McGraw and associates have purchased the property of the Grafton Gas & Electric Company and will make extensive additions and improvements to the electric plant, which will double the present equipment of the station. The improvements include the installation of a 150-hp engine to operate a generator to furnish electricity to operate the street railway system; the erection of an addition to the boiler room, providing space for two new boilers. The cost of the work is estimated at about $20,000. The company contemplates building a coal tipple and bins later, to be used for storing coal.

WHEELING, W. VA.—It is reported that the Wheeling Electrical Company is contemplating making an application to the City Council for a 50-year franchise in this city. The company is connected with the Consumers' Electrical Company, the former owning the generating plant, and the latter being the distributing company. If a franchise is granted it is planned to consolidate the two companies as the Wheeling Electrical Company and increase the equipment of the electric plant.

BARRON, WIS.—Owing to the low water in the Yellow River the municipal electric light plant is unable to generate sufficient electricity to light the town. An engine was installed last winter, but is not capable of furnishing power enough to operate the whole system, and unless another engine of greater power is installed in the plant the city will not have electric light until next spring.

BAYFIELD, WIS.—Extensive additions and improvements are contemplated for the municipal light, power and water plant, including the installation of a new 500-hp Webster open feed water heater, one water tube boiler of 200-hp, a new smokestack 125 ft. x 6 ft. and a 500-gal, triple pump. J. T. Dohm is manager.

ELKHORN, WIS.—Plans are being contemplated for extending the municipal electric lighting system to the County Poor and Insane Asylum, a distance of three miles. William Pitz is manager.

MELLEN, WIS.—The Mellen Water & Light Company is contemplating changing its system from 133 to 60 cycles and establishing a day service after April 1. J. F. Pribnow is president and manager.

MINERAL POINT, WIS.—The Mineral Point Electric Light Company is planning to install a 100-kw steam turbine in its plant and establishing additional power circuits next spring. F. C. Ludden is manager.

MONROE, WIS.—The Monroe Electric Light & Power Company contemplates changing its system to 60 cycles and establishing a day service. W. P. Bragg is secretary and manager.

PESHTIGO, WIS.—The Peshtigo Lumber Company is contemplating changing the city lighting service from direct-current to alternating-current. S. D. Woodward is manager.

WATERLOO, WIS.—F. E. Peschel, village clerk, writes that about $5,000 will be expended on improvements to the electric light system, the work to be done by day labor. D. C. and William B. Jackson, Commercial National Bank Building, Chicago, Ill., are the engineers.

NANAIMO, B. C.—The Nanaimo Electric Light & Heat Company is planning to erect a large dam three miles from here to increase the output of its plant.

CAMPBELLFORD, ONT.—John S. Fielding, 15 Toronto Street, Toronto, Ont., writes in regard to the proposed municipal power plant for Campbellford, that bids are wanted for turbine wheels with a rating of 1350 horse-power, at 25-ft. head. He also states that Bogue & Buchanan, of Peterboro, have secured the contract for constructing head race, power house and tail race, and the Allis-Chalmers-Bullock Company the contract for the electric equipment. The total cost of the proposed plant is estimated at $60,000.

DUNVILLE, ONT.—The Dunville Electric Light Company is changing its street lighting system from Thomson-Houston arc lamps to alternating-current enclosed arc lamps. James Rolston is treasurer and manager.

GRANBY, ONT.—The village is increasing the equipment of the municipal electric light plant by the installation of a 150-kw, alternating-current dynamo to furnish electricity for incandescent lamps. F. B. Farnsworth is superintendent.

OTTAWA, ONT.—The city engineer has been instructed to confer with C. H. Keefer, civil engineer, of this city, to prepare plans for developing 30,000 horse power by the construction of a hydro-electric plant on the Ottawa River. As soon as his report is completed a by-law will be submitted to the ratepayers.

PORT ARTHUR, ONT.—We have been informed that the City of Port Arthur has authorized Smith, Kerry & Chace, Confederation Life Building, Toronto, to make a survey for power development at Silver Falls on the Kaministiquia River, about 25 miles distant from Port Arthur.

TORONTO JUNCTION, ONT.—E. R. Clarkson has been appointed receiver for the Stark Telephone, Light & Power Company.

WESTON, ONT.—Action has been started by Lorenzo Wynn to have the town restrained from entering into an agreement with the Stark Telephone, Light & Power Company for supplying the town with electricity for lamps and motors. According to the agreement the Stark company is to pay the town $500 for the use of the municipal plant and guarantees to supply electricity to consumers to operate motors for 2½ cents per kilowatt-hour, and for lamps at 10 cents per lamp per month, with a discount of 20 per cent if payment is made before the 15th of the month. It also agrees to furnish arc lamps of 1000 candle power at $50 per lamp per year.

WINGHAM, ONT.—The Town Council is considering an expenditure of about $25,000 for repairs to the hydro-electric plant in this place. W. J. Wyles is manager.

New Industrial Companies.

THE AUTOMATIC HOME TELEPHONE COMPANY, of Wilmington, Del., has been incorporated, with a capital stock of $200,000, by I. A. Morrison, S. L. Morrison, Ray Blaisdell, A. J. Vernier, Fred G. White, C. R. Tombaugh, H. S. Allen, A. F. Mett and E. B. Kipp, all of Pontiac, Ill., and Charles F. Branson, of Cadiz, Ohio. The company proposes to manufacture and deal in electric contrivances for transmitting sounds and signals.

THE ELECTRIC LIABILITY & CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $5,000. The directors are Mitchell Bisher, Joseph Bisher and Leo Rochlitz, of New York.

THE MURPHY ELECTRICITY RECTIFIER COMPANY, of Rochester, N. Y., has filed articles of incorporation, with a capital stock of $1,000,000. The directors are Walter B. Duffy, George W. Aldridge and Thomas J. Murphy, of Rochester.

THE NATIONAL ELECTRICAL MANUFACTURING COMPANY, of Oakland, Me., has been incorporated, with a capital stock of $100,000, by G. S. Jewett, of Norridgewock; J. Harry Myers, O. M. Sibley, V. C. Totman, S. J. Foster, Harry L. Hunton and D. M. Marshall, of Oakland.

THE NEW ENGLAND MACHINE & ELECTRIC COMPANY, of Providence, R. I., has been incorporated, with a capital stock of $3500, by Frederick W. Smith, Elizabeth H. Smith and Roscoe M. Dexter. The purpose of the company is to engage in the business of general machinist and electrical contractor, and of dealing in electrical machinery, supplies, etc.

THE S. S. BRADY COMPANY, of Boston, Mass., has filed a certificate of incorporation, with a capital stock of $3,000, for the purpose of conducting a general electrical machinery and supply business. The officers of the company are Stephen S. Grady, president; Herbert I. Perry, of Rockland, treasurer.

THE TWICE TWO CYCLE ENGINE COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $10,000, by H. S. White, E. R. Casebeer and H. R. Kingsley. The company proposes to manufacture and sell engines.

New Incorporations.

MONTICELLO, IND.—The Tippecanoe Electric Light & Power Company has been incorporated with a capital stock of $75,000, by Abraham S. Straus and others.

PELLSTON, MICH.—The Pellston Light & Power Company has been incorporated with a capital stock of $25,000.

SALLISAW, OKLA.—The Southern Light & Power Company has been incorporated, with a capital stock of $20,000, by William A. Langdon and Webster Ray, of Sallisaw, and Richard Jackson, of Chicago, Ill.

WASHINGTON, PA.—The Monongahela & Carroll Street Railway Company has been chartered, with a capital stock of $12,000, to construct a street railway from Monongahela into Carroll, a distance of two miles. E. B. Hartman, Jr., of Pittsburg, is president of the company.

GORMAN, TEX.—Articles of incorporation have been filed for the Gorman Light & Power Company, with a capital stock of $15,000, by E. B. Winters, S. B. Bowles and W. A. Wallace.

SALT LAKE CITY, UTAH.—The Beaver River Power Company has filed articles of incorporation, with a capital stock of $500,000. The company proposes to build power plants for the generation and distribution of electricity. The directors are L. L. Nunn, E. P. Bacon, C. S. Ruffner, A. D. Smith, L. B. Fuller, W. L. Blearsach and F. F. Steigmeyer.

SHEPERDSTOWN, W. VA.—The Shepherdstown Electric Light & Power Company has filed articles of incorporation, with a capital stock of $20,000. The incorporators are Samuel J. Hodges, Harrison Schley, E. H. Rinehart and others.

Legal.

SOUTH TEXAS TELEPHONE COMPANY.—H. T. Huntington, of New York, N. Y., and F. C. Smith, of San Antonio, Tex., have filed a suit in the district court for the appointment of a receiver for the South Texas Telephone Company. The case is set for Jan. 15, and a temporary injunction restraining the company from disposing of any of its property was granted. Messrs. Huntington and Smith obtained judgment against the company for $47,000 for alleged breach of contract.

INJUNCTION AGAINST ELECTRIC LIGHT PLANT REFUSED.—In an action against the United Electric Light Company, an injunction closing down the plant of the company, was denied in the following closing the plant of the company, was denied in the following language: "The service which the defendant is rendering is of quasi public character; and in the particular neighborhood, embracing a large territory, for whose benefit this plant is operated, the defendant company is the only institution of its kind from which electric light, heat and power can be obtained. It supplies over 5,000 customers, and the range of its service takes in the lighting of the streets and schools belonging to the public, and our bridges that span the rivers in this section of the city obtain both light and power therefrom. Factories are dependent on this station for power to operate their machinery, and a great number of apartment houses operate their elevators by power received from the defendant. It is thus made patent that the injury that would be wrought, not only to the defendant, but to the public as well, by the issuance of an order that would cause a cessation in the operation of this plant, would be of an exceedingly grave and serious character. Some vibration, I presume, must necessarily ensue when machinery of any kind is employed, and, if institutions of the defendant's character are entitled to exist at all, all that can in fairness be exacted of them is that they will employ every agency in their power to reduce this to a minimum." Floyd-Jones vs. United Electric Light Co., New York Supreme Court, 106 N. Y. Supp. 648.

TELEGRAPH ANTI-TRUST SUITS.—New York Supreme Court Justice Hendrick, in a decision last week, defeated Attorney-General Jackson's effort to begin an action against the Western Union Telegraph Company and the Postal Telegraph Cable Company, restraining them from entering into a combination in restraint of trade. At the time the suit was entered, both companies denied that any merger was contemplated. Mr. Jackson, on July 8, obtained from Justice Platzek an order directing Clarence H. Mackay and other directors of both companies to appear before a referee and to testify regarding certain contracts and arrangements between the two companies. This order is now vacated by Justice Hendrick. In his decision in favor of the two companies, Justice Hendrick says: "The vital question to be determined is whether or not a telegraph company manufactures, produces or sells a commodity or article in common use, such as is within the prohibition of the Donnelly Anti-Trust act. If it does, then this motion should be denied; if not, it should be vacated." The court goes on to add that telegraph companies are not included under this act, and holds that the transmitting of messages from one point to another does not make the messages so transmitted a commodity, within the meaning of the act. "The reasons urged by the Attorney General," the court states, "might be laid before the Legislature, to the end that laws may be enacted to correct any evils found to exist under the present statutes of this State. It is my duty simply to declare the law as I find it, and, after a very careful examination of the question involved, I am of the opinion that the motions must be granted to vacate. The Attorney-General, at the time he obtained the order from Justice Platzek, said he intended to begin suits to restrain the two companies "from doing in this State any act in, toward, or for the making or consummation of the contracts, agreements, arrangements or combination set forth in the petition." The petition stated that the telegraph companies had entered into a combination which created a monopoly in the receipts.

WIRELESS TELEPHONY.—The *New York Herald* has the following: "Because of contentions over a patent an injunction may be issued prohibiting the use of wireless telephones which have been installed aboard the ships of the navy by the De Forest Wireless Telegraph Company. The Poulsen Wireless Telephone Company, controlled by the Amalgamated Radio Telegraph Company, Limited, of London, of which Lord Armstrong is president and holds control, alleges infringement of its patent rights and is reported to be preparing suit against the De Forest company. In view of the importance this suit will have for the navy, Captain Francis M. Barber, retired, on special duty for the United States Government in Paris, has informed officials at Washington of the Poulsen company's claims and its plans for seeking redress. The bone of contention is the patent governing the use of the hydrogen arc enveloper employed in connection with the wireless telephones, in which the spark system obtaining in wireless telegraphy cannot be utilized because of the frequency of the vibrations caused by the click of the telegraph instrument. For this reason resort is had to the wave system, but although vibrations as great as eighty thousand a second can be recorded, there is some difficulty in accurately recording vibrations of high frequency which occur when one talks through the telephones. Poulsen, it is alleged, discovered that by enveloping in hydrogen the arc where these vibrations are first recorded the vibrations could be more easily recorded. He patented this idea. De Forest uses in his wireless telephones an alcohol flame which produces hydrogen to envelope the arc. Poulsen, it is alleged, contends this is an infringement of his patent. De Forest asserts that the idea was used before Poulsen obtained his patents, and that the Poulsen patents do not cover the idea of producing the hydrogen enveloper which he has worked out. As a result Poulsen, it is said, will call for an injunction against the use of the De Forest instruments on the battleship fleet and on other ships of the navy, including the six torpedo boat destroyers, which started out for the Pacific Coast on Dec. 2."

Obituary.

MR. JOHN W. McNAMARA, formerly president and general manager of the United Traction Company, at Albany, N. Y., died recently. Mr. McNamara was also interested in the Union Railway Company, of New York City, N. Y.

MR. J. C. LAFFARGUE.—Notices have been received in this country of the death in Paris, at the early age of forty-three, of Mr. Joseph Clement Laffargue, well known to many of our readers as editor of *La Nature*. He was a practicing electrical engineer and formerly manager of the municipal lighting plant of the Halles Centrales. He was also connected with the municipal control of the lighting systems of Paris. He was general secretary of the Federation des Mecaniciens-Chauffeurs-Electriciens. He had the decorations of chevalier of the Legion d'Honneur and oficier de l'Instruction Publique. All who knew Mr. Laffargue appreciated him for many sterling qualities of heart and head, and his loss will be deeply felt. He leaves a wife, a son and a daughter.

DR. COLEMAN SELLERS.—We regret to note that Dr. Coleman Sellers, the distinguished engineer and scientist, died at his home in Philadelphia, Dec. 28, aged 81 years. Dr. Sellers suffered from a general physical breakdown and but little hope of his recovery was held from the beginning of his illness. He was born in Philadelphia Jan. 28, 1827. His education was obtained at private schools and at Bolmar's Academy, West Chester, Pa. He first went to work in 1846 as a draughtsman in the Globe Rolling Mill, Cincinnati, Ohio, and was soon advanced to superintendent. Three years later he entered the service of Niles & Company, locomotive builders, and remained with them for five years as foreman. In 1856, at the request of his kinsman, the senior partner of the firm of Sellers & Company, he returned to Philadelphia and entered that establishment as chief engineer. Later he was admitted to the firm as a partner. He retired from active interest in the business in 1888 and had since devoted himself to private practice as a consulting engineer. One of the first and most important of Dr. Sellers's inventions was a coupling device for shafting. His feeds for lathes and other machinery tools were also an important advance in the art. His other inventions have done much to advance the efficiency of mechanical appliances. In 1861 he recommended the use of absorbent cotton for surgical purposes, which has since become indispensable. In connection with his experiments in photography he proposed the employment of glycerine to keep the plates damp. In 1889 Dr. Sellers was called upon by several capitalists to consider the possibility of developing the water power of Niagara Falls. Dr. Sellers represented America in the International Niagara Commission of five members, with Lord Kelvin as chairman, which was established in London in 1890. Since that time he had been the acting engineer of the Cataract Constructing Company and the chief engineer of the Niagara Falls Power Company. To this work Dr. Sellers brought the advantage of his wide engineering experience in meeting many problems presented by the novel character and magnitude of the undertaking. The King of Sweden in 1887 conferred on Dr. Sellers the Royal Norwegian Order of St. Olaf. In 1888 he received from the Stevens Institute the degree of D. E., and one year later the University of Pensylvania conferred upon him the degree of D. Sc. Dr. Sellers was a member of the board of managers of the Franklin Institute, and was its president for five years. He was also president of the American Society of Mechanical Engineers and of the Pennsylvania Museum and School of Industrial Art. He was a member of several engineering societies. His son, Mr. Coleman Sellers, Jr., is well known, and succeeds to much of his father's work in the engineering field.

Personal.

MR. F. ALTREDE, of Hungary, a royal engineer, commissioned to examine electrical power installations in America, was recently in California, where he visited many of the notable plants in that State.

MR. ARTHUR WAINWRIGHT, of South Norwalk, Conn., State superintendent of lighting for the Connecticut Company, has resigned his position to become manager of the Mohawk Gas Company, of Schenectady, N. Y.

MR. HENRY F. SCHMIDT, of Buffalo, N. Y., electrical and steam heating engineer, after Jan. 1, will become an assistant to Mr. J. R. Bibbins in the publication department of the Westinghouse Machine Company.

MR. B. S. READ, manager of the Louisville, Ky., district of the Cumberland Telephone & Telegraph Company, has been promoted to the superintendency of the New Orleans, La., district. Mr. Read assumed the position Jan. 1.

MR. CLARKE CARSON, of Davenport, Iowa, has succeeded Mr. Francis Stewart as manager of the Washington, Iowa, Gas & Electric Company, Mr. Stewart leaving the field to associate himself with the American Pearl Button Company.

MR. CHARLES F. TURNER has been appointed superintendent of the Columbus, Delaware & Marion Railway Company, of Columbus, Ohio. Mr. Turner will have supervision over the power houses, sub-stations and all rolling stock of the company.

MR. WILLARD B. STOUGHTON, of Messena, Can., has been appointed superintendent of the electric light plant of the Danbury & Bethel Gas & Electric Light Company, of Danbury, Conn. He succeeds Charles R. Hodgson, who will go to Mexico City, Mex.

MR. JULIUS AUERBACH, president of the Electrical Accessaries Company, has returned from his European trip, where he spent six weeks in Budapest and Augsburg, in behalf of the "Just" tungsten lamp, which his company is importing into the United States.

MR. C. M. HOBBS, general manager and of the owners of the Nevada-California Power Company, operating at Tonopah and Goldfield, Nev., has retired as general manager. Mr. Delos A. Chappell, of Denver, who was recently elected president of the company, now assumes the general management of the affairs.

MR. LLOYD LYONS has been appointed secretary of the Mobile Light & Railway Company, of Mobile, Ala. Mr. Lyons was formerly assistant manager and assistant treasurer of the San Juan Light & Power Company, of San Juan, P. R. Mr. J. E. Z. Watson, who has held the position of secretary of the local company for more than a year past, has returned to St. Louis, Mo., where he will engage in business.

MR. C. M. SPONSEL.—Mr. C. M. Sponsel, of Hartford, a consulting engineer, has been appointed manufacturing superintendent of the Stanley Company by vice-president C. C. Chesney. For the past four months Mr. Sponsel has been in the plant familiarizing himself with the workings of the various departments. Mr. William J. Baughman will continue to superintend the heavy machine departments and the supply departments.

MESSRS. D. C. AND WILLIAM B. JACKSON, engineers and experts, announce some changes in office arrangements. The office, which has formerly been at Madison, Wis., due to the fact that Prof. D. C. Jackson was formerly professor of electrical engineering at the University of Wisconsin, has now been moved to the Commercial National Bank Building, Chicago. Mr. William J. Crumpton will be in immediate charge of the Chicago office. A Boston office will also be maintained as before.

MR. A. W. ZAHM has resigned as manager of the Fort Dodge Light & Power Company, Fort Dodge, Iowa, and expects to take a vacation for his health in New Mexico. He intends while there to investigate and report on a new water power project, returning later to engage in the central-station business in Iowa or Minnesota, where he has been so successfully at work in this line for a number of years. He will be succeeded at Fort Dodge by Mr. Wm. B. Foshay, formerly of Hutchinson, Kan.

MR. C. H. NORWOOD, of Chicago, announces that he has given up all sales agency arrangements and will devote his entire time to contract engineering work, making a specialty of industrial and railroad power plants, electrical equipment for railroad bridges, motor applications for industrial and railroad work, and electrical pumping apparatus. Mr. Norwood advises us that he is at present installing a power plant and complete electrical equipment for one of the largest draw bridges in the world located at Portland, Ore., equipped throughout for alternating current.

MR. HARRY B. KIRKLAND.—A complimentary dinner was tendered Mr. Harry B. Kirkland, of the National Metal Molding Company, at Delmonico's, Dec. 27, by Major George L. Gillon, vice-president and treasurer of the Watson-Stillman Company. Among the guests present were Henry L. Doherty, Richard Jordan, Charles N. Boynton, W. S. McGowan, Charles A. Schieren, Jr., Charles Smith and Geo. W. Elliott. During the evening the guest was presented with a handsome umbrella by Major Gillon. Mr. Kirkland has just returned from a successful three months' trip to the Pacific Coast.

PROF. D. C. JACKSON.—Prof. Dugald C. Jackson, head of the department of electrical engineering at the Massachusetts Institute of Technology, has gone to Chicago, at the invitation of the city officials, to assist the municipal government in devising a system of bookkeeping in connection with the business of the Chicago Telephone Company. Professor Jackson was chairman of the Chicago telephone commission, and is therefore familiar with the business transactions and methods of the company. Recently he has been engaged in expert work in the West, appraising the property of the Minneapolis General Electric Company. He was chairman of the board of arbitration in the matter between the city of Boston and the Edison Electric Illuminating Company.

MR. J. W. AGER, electrical aide in the Bureau of Yards and Docks, U. S. Navy Department, has resigned his government position to enter the employ of Muralt & Company, engineers, 114 Liberty Street, New York, as manager of their Southern office in the Title Guarantee Building, Birmingham, Ala. Mr. Ager is a graduate of Columbia, where he took the degree of M. E. in 1903 and of the Massachusetts Institute of Technology, where he obtained the E. E. degree in 1904. He then was engineer with the Western Electric Company in New York, during 1905 and 1906, and was in the service of the United States Navy Department from 1906 until now. He was last identified with the engineering and construction work being carried out in connection with the movement to consolidate the power plants in the various U. S. navy yards. Muralt & Company have obtained several municipal and government contracts in the Southern territory, and Mr. Ager will undoubtedly prove a very valuable acquisition for them in connection with this work.

MR. O. BAERWINKEL, who has for some time past been prominently identified with the Excello Arc Lamp Company, has resigned for the purpose of taking up a new proposition in Europe. Mr. Baerwinkel sails on the *Kaiserin Auguste Victoria* on Jan. 4. A pleasant incident of his departure from the Excello Arc Lamp Company was the presentation to him by the office force of a handsome diamond locket suitably engraved. Mr. Baerwinkel has had a life of considerable commercial activity in Germany in different lines. He spent four years in a responsible position in England and, as is generally known, travelled for six British concerns in the British Colonies and far eastern countries. During his co-operation with Mr. Hirschberg in the Excello Arc Lamp Company, he has been largely instrumental in building up the business which has taken remarkable dimensions in a comparatively short time. Although the proposition he is going to take up in Europe will be a considerable step in advance, his departure from this country will be greatly regretted by his numerous American friends, both business and otherwise.

MR. W. R. ROBERTS.—On Jan. 1, Mr. William R. Roberts, now manager of the Atlanta exchange of the Southern Bell Telephone Company, will become the special agent of the company, succeeding Judge H. E. W. Palmer. Mr. Roberts has been connected with the Bell Telephone Company for the past six years. Prior to that time he was one of the best-known and most popular newspaper men in Atlanta. For a long time he was with *The Atlanta Journal*. When the old *Atlanta News* was organized he was one of the prime spirits of that lively newspaper. After the demise of *The News*, Mr. Roberts was for a time connected with *The Constitution*. He left *The Constitution* to go with the Bell Telephone Company, with which company he has been since that time. Judge H. E. W. Palmer, the present special agent of the company, has been appointed general attorney, succeeding Hunt Chipley, who is to be general counsel of the American Bell Telephone Company. Mr. C. F. Roddy, cashier of the Atlanta exchange, will succeed Mr. Roberts as manager of the Atlanta exchange. Mr. Roddy has been connected with the company for a number of years, and is one of its most valuable employees.

Business Notes.

THE ROBERT GAIR COMPANY, Brooklyn, has recently installed a large number of "Radiante" lamps in its factory. These lamps are the well known product of Felix Hamburger, New York.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., announces that its business for 1907 shows a very marked increase over that of any previous year in the history of the company, a fact which reflects great credit upon the able management of Mr. A. C. Garrison.

THE BRISTOL COMPANY, of Waterbury, Conn., was awarded a silver medal for its recording instruments at the Jamestown Exposition. Its recorders have received high awards at every exhibition where they have been entered and shown, as competitors, including those of recent years at Paris, Chicago and St. Louis.

THE ELECTRICAL ACCESSARIES COMPANY is now importing a full line of commercial "Just" tungsten lamps, not alone 25, 40 and 100-cp for 100 to 120 volts, but also 50-cp lamps for 200 to 250 volts. The president of the company, Mr. Julius Auerbach, who has just returned from a visit to the Just factories at Budapest and Augsburg, has been successful in making arrangements for large quantities of lamps to be shipped to the United States, so as to be able to ship promptly any quantity from New York stock. He states that the 25-cp lamps are a step in advance which will make the "Just" tungsten lamps still more popular. The most important development, of course, is the high-voltage lamp, which is now being imported. The repeated official tests of the last few months have, he states, shown that the life of the "Just" tungsten lamp is in every respect satisfactory; in fact, the Electrical Accessaries Company is ready now to guarantee the life of the "Just" lamp.

WEBER GAS ENGINES.—A careful service and economy test of the 250-hp Weber gas engine and suction gas producer installed in the large manufacturing plant of McClary Manufacturing Company, London, Ontario, has, it is said, demonstrated conclusively that it surpassed the guarantee called for in the contract. In regular operation less than .95 of a pound of coal per horse-power-hour is used. Their total cost for generating power, including fuel, labor, supplies, depreciation and interest on the investment, shows, it is alleged, a handsome profit over the price of electrical energy from the distant Niagara Falls power companies. The Weber Gas Engine Company, of Kansas City, Mo., is at work installing several 350 horse-power gas power plants in cotton mills, electric light plants and flour mills, as well as a number of smaller units.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

AMERICAN ELECTRO-THERAPEUTICAL ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, Walter S. Mower, London, Ont.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Mulholland, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby. 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual Meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Thursday of each month.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles West. Next meeting, Chicago, January 21, 22 and 23, 1908.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

MISSOURI STATE ELECTRIC LIGHT ASSOCIATION. Secretary, C. Z. Pierson, St. Charles, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn. Next meeting, Chicago, January 21, 22 and 23, 1908.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January 15 and 16, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

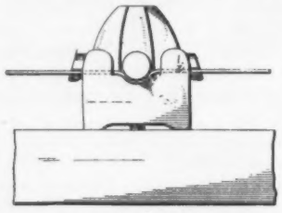
Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 24, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

874,411. SYSTEM OF ELECTRICAL TRANSMISSION AND PROPULSION; Maurice LeBlanc, Paris, France. App. filed March 31, 1904. An electrical transmission line, carrying alternating currents of a wave length which is short with reference to the length of the line, which has the ratio of its capacity to its self-induction artificially increased at points along the line in a manner to prevent the superelevation of voltage, the consecutive distances between which points are short with reference to a half wave length of the current, substantially as described.

874,445. INSULATOR; Albert L. Shears, Seattle, Wash. App. filed March 5, 1907. A form of porcelain cleat insulator having grooves



874,445.—Insulator.

on its upper surface in a special rectangular formation, and which co-operate with certain lugs at the side to bind the circuit wires in place.

874,477. RAILWAY SIGNAL; Harry M. Abernethy, Cleveland, Ohio. App. filed April 3, 1906. A railroad signal of the type operated by a gear train driven by an electric motor, the motor being clutched into a relation to raise either the danger or the caution signal according to the completion of certain circuits. The signals are dropped to danger by a magnet-operated trip.

874,483. ELECTRIC FIRE AND BURGLAR ALARM; Melancthon J. Briggs, Philadelphia, Pa. App. filed April 25, 1906. A combined electric fire and burglar alarm, including mechanical features and electrical circuits. Has an annunciator and thermostats and mechanically-operated circuit closing devices.

874,496. PROCESS OF RENDERING SOLUBLE IN WATER THE NICKEL AND COPPER CONTAINED IN SULFID ORES AND MATTES; Walter S. Gates and Herbert H. Dow, Midland, Mich. App. filed March 22, 1906. A process for making nickel and copper sulfid ores soluble in water electrolytically.

874,511. INTERRUPTER; William Kaisling, Chicago, Ill. App. filed Jan. 3, 1907. An automatic interrupter of a type employed in the selectors of automatic telephone exchanges. Covers mechanical features of construction.

874,527. ORE REDUCING FURNACE; James McLoughlin, Rye, N. Y. App. filed March 21, 1906. A vertical furnace having the general appearance of a cupola or blast furnace and which has a chamber at its lower part through which the electric current is passed.

874,531. AUTOMATIC MOTOR STARTER; William C. O'Brien, Baltimore, Md. App. filed Oct. 23, 1905. An automatic starter for electric motors operating to cut out the starting resistance as the motor acquires speed without the use of dashpots or other mechanical retarding devices.

874,552. WIRE FASTENER; Sylvester Wilburn and Thomas E. Smith, Tunis, Tex. App. filed Sept. 9, 1907. A form of insulator having clamping jaws of the type which bind upon the wire by the pivotal movement of a cam wedge.

874,558. ALTERNATING DIRECT-CURRENT SYSTEM OF CONTROL; Howard L. Beach, Wilkinsburg, Pa. App. filed March 3, 1906. Relates to the control of the trolleys for electric locomotives adapted to take electric current from an overhead or a third-rail system as desired. Includes electrically operated pneumatic apparatus.

874,559. SYSTEM OF CONTROL; Howard L. Beach, Wilkinsburg, Pa. App. filed March 3, 1906. A system for the control of motors adapted to be operated by either direct or alternating current. Provides means whereby the circuits of the system may be arranged automatically in accordance with the character of the energy supplied.

874,564. ELECTROLYTIC APPARATUS FOR THE MANUFACTURE OF NITROCELLULOSE; Gaston C. DeBrailles, Paris, France. App. filed March 10, 1906. A receptacle is provided with a perforated diaphragm dividing it into upper and lower chambers and has electrodes of gilded platinum wire located in the lower chamber.

874,567. ELECTRIC CONTROLLER; Roy W. Brown, Amsterdam, N. Y. App. filed Feb. 19, 1907. A construction of rheostat having a contact which is spring actuated to move in one direction and an electromagnet for controlling said contact.

874,601. SWITCH FOR HIGH POTENTIAL CIRCUITS; Joseph N. Kelman, Los Angeles, Cal. App. filed April 8, 1907. An oil bath switch of the type for controlling three-phase, high-potential circuits of 60,000 volts or over. Has ribbed insulators supporting plungers which dip into the oil bath.

874,602. TELEGRAPH KEY; John P. Kinney, Pocatello, Idaho. App. filed April 23, 1907. Telegraph key of the "Mecograph" type adapted for either right hand or left hand manipulation.

874,608. DANGER SIGNAL; Clevia J. Luther, Desloge, Mo. App. filed Aug. 13, 1907. An apparatus for exhibiting a danger signal in case of fire or floods on a railway system.

874,628. PROCESS OF PRODUCING STEEL; George O. Seward, East Orange, N. J. App. filed July 6, 1907. The process of producing steel which consists in fusing iron as an electrode in the presence of refining slag.

874,630. THIRD-RAIL ATTACHMENT FOR ELECTRIC CARS; George H. Sohn, Lincoln, Cal. App. filed June 10, 1907. A form of current collector for underground trolley systems having a special truck which runs upon the conduit groove and from which depends the shoe engaging the underground trolley.

874,635. REGISTERING DEVICE; Ralph Storm, Joseph F. Underwood and Robert Jackson, Waterloo, Iowa. App. filed May 10, 1907. A registering device for use with railway systems by which a record can be kept of passing trains and their stoppage for orders.

874,638. CONTROLLER; Emmett W. Stull, Norwood, Ohio. App. filed May 3, 1906. Provides means whereby an injured or disabled motor may be cut out of circuit without interfering with the regulation of the remaining motor or motors.

874,665. BRUSH HOLDER FOR ELECTRIC MACHINES; Giorgio Finzi and Emilio Tallero, Milan, Italy. App. filed April 2, 1906. A brush holder of the type having a plunger gripping a carbon block at its extremity and spring impelled to engage the commutator. Has two independent systems of springs acting at different points on the plunger.

874,690. LINE TESTER; Edwin S. Lincoln, Brookline, Mass. App. filed Feb. 11, 1907. A testing outfit for telephone and telegraph and similar electrical circuits by which the condition of the circuit under test is determined by the aid of a telephonic receiver.

874,707. ELECTROLYTIC REFINING OF TIN; Elmer A. Sperry, Brooklyn, N. Y. App. filed Sept. 15, 1906. The method of refining tin which consists in melting the alloy or tin-bearing material to improve its slime coagulating qualities and electrodepositing the resulting mass in a suitable electrolyte.

874,745. TELEGRAPHY; Patrick B. Delany, South Orange, N. J. App. filed June 13, 1903. A form of detector for wireless telegraph systems including the relay circuits and tape recorder.

874,780. THERMO-ELECTRIC ELEMENT; Albert L. Marsh, Lake Bluff, Ill. App. filed Jan. 17, 1907. A thermo-electric couple, one element of which consists of an alloy of vanadium and a nickel.

874,781. TEMPERATURE CONTROLLING DEVICE FOR FURNACES; Allan G. Mather and Ernest C. Shaw, Milwaukee, Wis. App. filed April 7, 1905. Electromagnetic mechanism having a thermostatic circuit closer for controlling the operation of a motor connected to the air draft of a furnace.

874,792. ELECTRIC HORN; Leon Chalas, Edouard Requillart and Camille Contal, Levallois-Perret, France. App. filed Sept. 20, 1905. Horn for automobiles of the type having a diaphragm vibrated by an electromagnet.

874,795. SAFETY FUSE; Joseph Sachs and Frank D. Reynolds, Hartford, Conn. App. filed March 19, 1906. Construction of cap for a safety fuse by which a good electrical connection is made to the fuse element.

874,796. SAFETY FUSE; Joseph Sachs and Frank D. Reynolds, Hartford, Conn. App. filed April 5, 1906. Construction of safety fuse having a wire electrically connected to one of the end caps through which the current passes after the main fuse is blown and which has an indicator on the exterior of the fuse casing.

874,797. SAFETY FUSE; Joseph Sachs and Frank D. Reynolds, Hartford, Conn. App. filed April 18, 1906. Relates to modifications of the above.

874,798. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed April 18, 1906. A safety fuse comprising terminals, a holder of insulating material, a pocket integral with said holder, and wires connected at one end with the respective terminals, and at the other electrically connected with each other by a fusible joint within the said pocket.

874,826. NULLIFYING DISTURBANCES IN TELEGRAPHIC OR OTHER SIGNALLING CIRCUITS; Edward Blakeney, Ossining, N. Y., and Robert E. Chetwood, Jr., Elizabeth, N. J. App. filed May 29, 1906. A form of bridge system adapted to balance exteriorly received impulses.

874,834. INSULATOR AND PROTECTOR FOR ELECTRIC CONDUCTORS; Thomas C. Copping, Houston, Tex. App. filed Jan. 24, 1906. A casing for electric wires or conductors adapted to insulate them from trees, posts, etc., and protect them from injury by abrasion.

874,841. STORAGE BATTERY PLATE; William Gardiner, Chicago, Ill. App. filed April 26, 1906. A storage battery plate having a rectangular frame in which are received a plurality of drawers containing the active material.

874,860. INCUBATOR; Oliver P. Phillips, Amo, Ind. App. filed Oct. 24, 1906. Incubator of the type embodying a thermostat for automatically governing the temperature within the incubating chamber. Has a system controlled by a thermostat.

874,864. ELECTROLYTIC PROCESS FOR REFINING NICKEL; John N. Pring, New York, N. Y. App. filed Nov. 8, 1906. Relates to the purification of nickel and consists in dissolving crude nickel and treating it electrolytically in successive stages analogous to copper refining.

874,868. TELAUTOPHOTE; Sidney Rothschild, New York, N. Y. App. filed Sept. 6, 1906. Covers the transmission of images by electricity by means of synchronously rotating cylinders. Has a vacuum tube for the illuminating agent for the photographic reproduction.

874,869. CONTROL SYSTEM FOR ELECTRIC VEHICLES; Olof A. Sandborgh, Swissvale, Pa. App. filed March 3, 1906. Provides means for automatically completing circuit connections from one collecting device to a car when said device engages its supply conductor and for completing circuit connections from a second collecting device when the first is disengaged from the supply conductor.

874,895. MOTOR CONTROLLING TREADLE; Albert B. Mann, Cincinnati, Ohio. App. filed Dec. 4, 1906. A motor controlling treadle for operating laundry machines.

874,898. AUTOMATIC STARTING BOX; Thomas M. Morris, New Haven, Conn. App. filed May 3, 1907. Specially designed for use with telephone ringing machines. Automatically starts the power motor in case the same is stopped by a temporary interruption of the current thereto.

874,908. APPARATUS OR MEANS FOR THE PRODUCTION, TRANSMISSION AND DISTRIBUTION OF ELECTRIC CURRENTS; Charles E. Fritts, New York, N. Y. App. filed Nov. 23, 1886. The combination of an electric generator producing normally straight or unipolar currents, electromotive force, or potential; apparatus uniformly varying the same and therewith charging one or more condensers connected to the poles of the generator; and one or more lines having their ends connected to said poles through said condensers.